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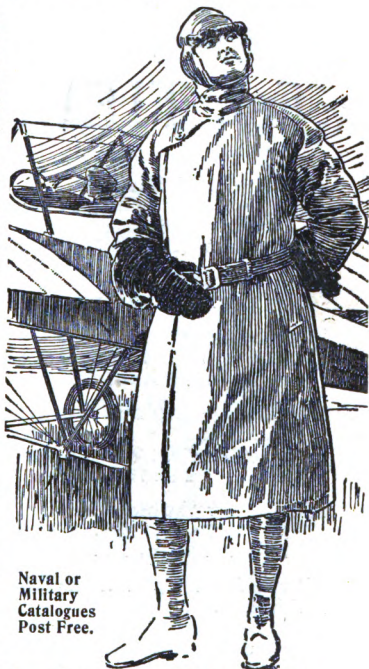
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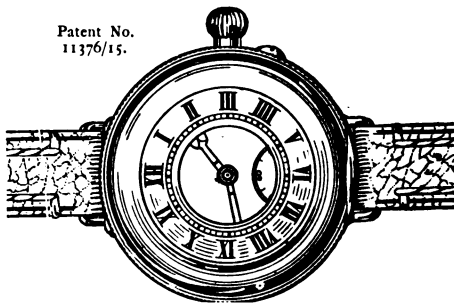
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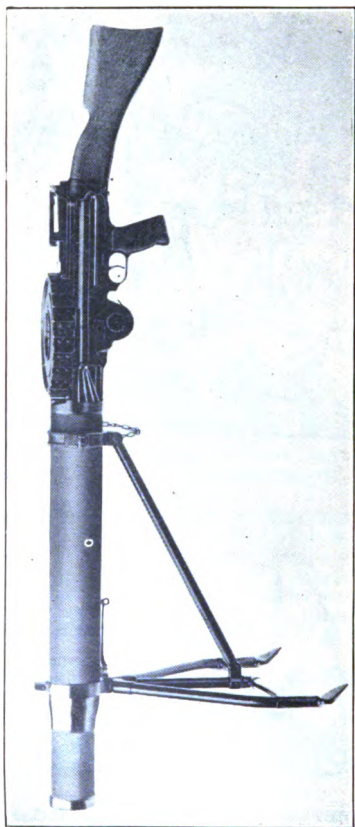
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PREFACE

PART I

THE writer, in producing this little book on the "Lewis Gun," wishes to impress on all the need for "proper handling" of a machine gun.

This "proper handling" can be gained for external uses by thorough attention to drill, the novice thereby gaining experience in the moving of the gun from one position to another.

The greatest importance should be attached to "correctness" in drill. Correct drill on the parade ground ensures proper discipline and carrying out of orders when in action, while laxity in this respect may lead to mistakes being made under fire which may have the direst effects.

There is often a great tendency to slur over movements and move quickly at the expense of accuracy. This is wrong, and

should be immediately checked in the training of a section.

Each beginner should be allowed to strip and assemble the gun himself ; by this means only can he attain proper familiarity with the working and parts of the gun. And at a later stage he should be asked to explain to the rest of the class the *backward* and *forward action* of the gun.

These are the only means for checking his real knowledge of the working of the gun ; for, although he may think he understands it perfectly when the Instructor has explained it, he will find at once where he is at fault when he has himself to handle the gun, or explain its working.

All connected with machine guns should be so familiar with the gun and its working, that it should come as second nature to them to manipulate or fire the gun, and correct any faults or stoppage that may occur.

PART II

In Part II the training of machine gun sections in the tactical handling of machine guns is briefly considered. Chapters are given on all the more important questions of tactical handling.

This subject cannot be dealt with at all fully in any book of this size ; a large book could be written on "The Use of Machine Guns in Trench Warfare" alone.

It is, however, of the utmost importance that all members of machine gun sections should be instructed in these matters.

While this is important, it is still more so that beginners should first master the mechanism and drill of the guns, and then proceed to tactical handling.

If tactical handling is dealt with too early in the training or course, its value is greatly decreased, if men are not able to "handle" the guns properly. The only way to gain this familiarity with the weapon is by strict attention to drill and mechanism (*vide* Preface to Part I).

N.B.—The "Characteristics of the Machine Gun" (Chapter X), if thoroughly known and understood by N.C.O.'s and men, will greatly assist them in tactical handling.

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AND

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Instruction on the Lewis Automatic Machine Gun

PART I

MECHANISM AND DRILL

CHAPTER I

THE CHIEF FEATURES OF THE GUN

1. SIMPLICITY.—The mechanism and working of the gun are so simple that they can easily be understood, after explanation, by any one, however unaccustomed they may be to the handling of machine guns.

Three days' instruction at most should suffice for the novice to thoroughly understand the working of all parts of the gun.

2. FEW PARTS.—The parts cannot be wrongly assembled and are very few in number.

Including every stud and smallest part of

the gun, the parts do not number more than sixty-two.

No force is needed in assembling or stripping the gun

3. OPERATION.—The Lewis Gun is operated by the trapping of a portion of the powder gases, formed by the explosion of each cartridge.

These gases follow the bullet down the barrel and a part of them escape through a port in the barrel, and after being cleansed, into a gas cylinder on the underside of the barrel, where they impinge upon a cup-faced piston, driving this to the rear.

The piston rod has on its lower side a rack, which, in its journey to the rear, engages in a pinion wheel, causing it to rotate and so wind up a circular spring inside it.

The gases having expended their energy, the spring drives forward the piston, by means of the pinion engaging in the rack of the piston.

4. COOLING.—The gun is cooled by air and not by water, this being an advantage, in that water is not always easily obtainable ; it also considerably lightens the gun for purposes of carrying.

Closely fitting round the barrel is an aluminium radiator, with fins running the length of the barrel.

5. RADIATOR.—Aluminium, while being a very light metal, is also a very good conductor of heat, and this enables the barrel to give off a great amount of the heat caused by the explosion of the powder gases.

This radiator is secured to the barrel by means of a *barrel mouthpiece* (screwed on to the muzzle). The shape of this barrel mouthpiece, and of a steel tube, called the front radiator casing, causes a draught to be set up by the gases as they rush forward.

This draught sucks cool air from the breech end of the radiator, under the *rear radiator casing*, towards the muzzle, thus cooling the gun.

6. VELOCITY.—This system of cooling, in addition to its other advantages, prolongs the pressure of the gases on the bullet, after it has left the barrel ; while it passes through the barrel mouthpiece, and to a lesser extent, through the front radiator casing. This causes a greater velocity to the bullet than it would otherwise have, and more than compensates for the small portion of gases used to operate the gun.

4 THE CHIEF FEATURES OF THE GUN

The bullet is found to have a greater velocity than is the case with a rifle of the same length of barrel.

7. RECOIL.—The design of the *barrel mouth-piece* and *front radiator casing* are found, while producing a satisfactory cooling system, to reduce the recoil of the gun to a minimum, owing to the gases as they rush forward striking against them.

8. MOUNTING OF THE GUN.—Owing to the almost entire absence of recoil the gun may be fired from the shoulder, with or without a rest, by a powerfully built man. For the same reason any tripod or mounting used for this gun need not be so strong, and so not so heavy, as is the case with other machine gun mountings.

Owing to the ejection opening being at the side, the gun may be rested in the lowest positions, without in any way interfering with the ejection.

9. GROUPING.—The absence of recoil ensures the best grouping results when firing. A complete novice may obtain an excellent group, where in the case of an ordinary machine gun much practice in holding would be necessary.

10. PORTABILITY.—The gun only weighs $25\frac{1}{4}$ lb., and so can easily be carried from one position to another by one man.

11. BUTTSTOCKS.—Two types of buttstock are issued with the gun:

1. The ordinary *rifle buttstock*, which enables the firer to keep a good hold on the gun, and to fire it with ease from the shoulder.

2. The *spade-grip*. This is of use in confined positions where it is required to reduce the length of the gun.

12. FEED BY MAGAZINES.—The feeding of the cartridges into the gun is carried out by means of circular steel magazines holding forty-seven rounds each. The walls of these magazines are corrugated, partly for strength and also to enable the magazine to be rotated mechanically, thus feeding the cartridge into the feed way in turn, by a step-by-step motion.

The shape of the magazine *ensures balance* and so satisfactory feeding for any position of the gun.

As each cartridge arrives in position in its turn, the magazine is securely locked by the right and left stop pawls catching against the corrugations in the magazine walls.

6 THE CHIEF FEATURES OF THE GUN

This prevents the magazine from rebounding or rotating too far.

Each cartridge is firmly held in position in the magazine. And once a magazine is properly filled and in good order it cannot give trouble.

CHAPTER II

THE PARTS OF THE GUN

THE parts of the gun may be conveniently divided into four headings or "Groups":

1. Barrel group (six parts).
2. Body group (four parts).
3. Working parts (nine parts).
4. Buttstock (two parts).

1. BARREL GROUP

1. THE BARREL is round in section, tapering towards the muzzle, where it is threaded to allow of the barrel mouthpiece being screwed on.

The chamber end of the barrel is also threaded, to permit its being screwed into the body.

About four inches from the muzzle the barrel has a small hole, called the "gas port," on its underside to allow the gas to pass through into the gas cylinder.

2. BARREL MOUTHPIECE.—This screws on to the muzzle by means of a *left-handed* thread,

and is a tubular nut of special shape. It is so designed that it causes the gases to produce the draught (referred to in Chapter I) for cooling purposes, and also to check the recoil.

This also secures the radiator ; it should, however, only be screwed on hand tight.

3. RADIATOR is made of aluminium, a very light metal, but a good conductor of heat. It fits closely over the barrel, and has fins running the length of the barrel, along which passes the cooling air.

4. RADIATOR CASING.—This consists of three parts. Parts 1 and 2 are made of thin tubular steel, slightly ribbed to prevent it shining in the sun.

1. The *front radiator casing*, which in conjunction with the barrel mouthpiece aids in the cooling system.

2. The *rear radiator casing*, which covers the aluminium radiator, and confines the cooling air to the radiator fins.

This part is permanently fixed to :

3. The *rear locking piece*, which on the top has a flat platform over which the magazine passes, and underneath a recess for the *body locking pin*, which by this means locks the barrel group.

It also has a hole underneath, into which

the gas cylinder fits, and is thereby kept in position.

5. REAR MOUNTING BAND.—The rear radiator casing has upon it three inches from the rear a metal band for mounting the gun. This band is necessary, as the thin radiator casing would not be strong enough.

6. CLAMP RING.—This fastens or clamps together the front and rear radiator casings.

Front Sight-adjusting Screw.—It also contains the front sight with its adjusting screw, for correcting errors in the sighting of the gun.

Clamping Ring Screw.—It is clamped by means of the *clamp ring screw*.

This *clamp ring* can be used as a *front mounting band*.

Gas Fittings

7. BARREL BAND AND GAS CHAMBER.—Over the “gas port” in the barrel fits a band called the “barrel band”; into this screws the *gas chamber*.

8. GAS REGULATOR.—Into the bottom of the gas chamber is screwed the *gas regulator*, which is turned or held in position at will, by the *gas regulator key*. It has two holes marked L. and S. (“Large” and “Small”).

These marks are put on the underside of the gas regulator to make it easy to see which hole is in use.

The gas regulator serves as a repository for all foreign solid matter which the gases may hold.

9. GAS CYLINDER.—On to the rear of the *gas chamber* is screwed the gas cylinder. For about 4 inches at its rear end it is flattened to allow for the teeth of the rack.

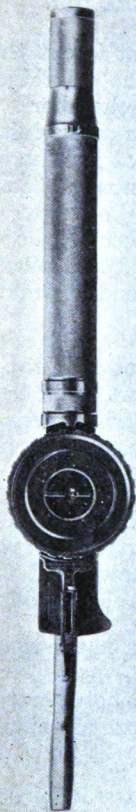
2. BODY GROUP

The body has two bores cut in it, running parallel to each other ; these bores are connected for the greater part of their length by the slot in which the striker post moves.

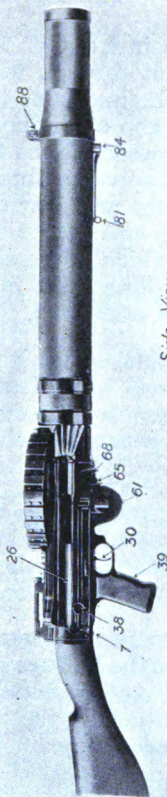
1. BOLT WAY.—The upper bar forms the bearing along which the bolt moves, and at the rear end has four key-ways cut, acting as paths for the cruciform lugs. These key-ways are called the **CRUCIFORM WAYS**.

At the front end of the cruciform ways is a recess called the **LOCKING RECESS** into which the cruciform lugs turn, thereby locking the bolt.

The top of the body has a slot cut in it, to form a passage for the *feed arm actuating stud*.



Top View



Side View

GUN COMPLETE, WITH MAGAZINE AND RIFLE BUTTSTOCK.

Also in front of this slot is cut the *feed-way* slot through which the cartridges pass from the magazine to the chamber.

The top of the body has on its left side a recess which forms the seat for the ejector, which operates through two small slots in the front and rear of the bolt way. There is also a small hole to receive the ejector stud, which is thereby held and pivoted.

The lower bore in the body forms a path for the *piston rod*.

The MAGAZINE POST is also on top of the body and has a feather cut upon it (called the *centre key*) to enable the magazine to be firmly secured in the correct position.

The CARTRIDGE GUIDE and CARTRIDGE GUIDE SPRING are on the left side of the feed ways, and hold the cartridge in position until the bolt pushes it down and into the chamber. These are part of the body cover.

The EJECTOR OPENING is on the right-hand side of the bolt way.

The *cocking handle* can be operated in a slot, either on the right or left side of the piston rod way.

2. The PISTOL GRIP and side pieces carry

the trigger mechanism and serve as a grip for the firer.

3. BODY COVER fits over the top of the body and forms a cover for the feed mechanism ; it has upon it the right and left stop pawls.

4. PINION CASING.—This forms a casing for the gear of the *return spring*, and has upon its front end a hook which attaches it to the body when fitted over the *pinion casing hinge pin*.

3. WORKING PARTS

1. PISTON ROD.—The head is cup-shaped and has four rings to collect the spare gasses. This has assembled on it the *piston*, the *rack*, the *striker post*, and *striker*.

The *sear* is cut in the flat surface at the rear of the rack.

The striker is attached by the striker fixing pin to the top of the striker post.

2. THE BOLT is cylindrical in form. It is fitted at the rear end with four *cruciform lugs*, which when turned into the locking recess resist the shock of discharge.

It is threaded internally at its rear end to receive the *feed arm actuating stud*.

On the underside is cut the curved *cam slot*, which serves as a way for the striker post.

There are two longitudinal recesses in the front of the bolt, which take the two extractors. These are strips of metal, which are notched at the end in order that they may grip the base of the cartridge and over which they are sprung when the bolt forces the cartridge into the chamber.

The front end of the bolt is recessed like the bolt of a rifle, to form a seat for the cartridge; there is a gap in the wall of the recess, through which the ejector strikes the cartridge and ejects it.

FEED ARM ACTUATING STUD screws into the rear end of the bolt, and has upon it four cruciform lugs corresponding to the lugs on the bolt. These lugs are purely for guiding the stud, and are not a means of locking the stud, as are the lugs on the bolt.

The stud does not turn when the bolt turns.

The top lug is called the *feed arm actuating stud boss*, and, working in the groove on the underside of the curved finger of the feed arm, causes it to have a transverse motion.

3. FEED ARM is fitted over the magazine post and is there pivoted; it is secured to the post by the feed *latch*.

The curved finger of the feed arm has on its underside a groove, along which the boss of the feed arm actuating stud works.

The main surface of the arm has the slot cut in it, through which the cartridge passes from the magazine to the chamber.

On the left side of this slot is a raised strip of metal called the "projection," which assists in the guiding of the cartridge. Also on the feed arm are assembled:—

1. The feed pawl, which is pivoted in the right stud.

2. The feed pawl spring, which is fastened to the left stud.

3. The left stud, which works the right stop pawl.

4. RIGHT AND LEFT STOP PAWLS.—These are fitted on studs inside the body cover, and are pressed outwards by the R. and L. stop pawls spring and engaged in corrugations in the magazine.

The right stop pawl, which is worked by the left stud, prevents the magazine from being rotated too far.

The left stop pawl prevents the magazine from rebounding.

5. RETURN SPRING.—This is a circular spring, and fits inside the return spring casing, which in turn fits inside the pinion, which is fitted inside the pinion casing.

One end of the spring is fixed by means of the return spring rivets, and the other end by the *return spring collet*, into which fits the *tension screw*.

The gear is held by the gear stop, when the pistol grip is not on, and the rack not in mesh with the pinion.

6. THE TRIGGER MECHANISM.—The trigger is enclosed in the *pistol grip* and is secured by the *trigger axis pin*.

At the front end is the *plunger* and *spring*; this holds up the sear unless trigger is pulled.

At the rear end is a knuckle joint which operates the sear, which is at the rear end of the pistol grip, and attached to it by the *sear axis pin*.

7. COCKING HANDLE.—This fits into the rear end of the piston rod at either side, and works backwards and forwards along narrow slots cut in the side of the body.

It can only be fitted on when the piston rod is in the farthest back position.

8. SAFETY SLIDES.—These are on each side of the body, and are narrow strips of steel, which can be slid over the slots, which form a way for the *cocking handle*; they then form a protection against dust.

They have slots cut in them, so that the cocking handle can be firmly held in the ready-to-fire position; they then form a safety catch.

4. BUTTSTOCKS

1. RIFLE BUTTSTOCK.—This part need never be stripped. It fits into the body, and is held there in position by the buttstock catch.

The *tang* of the buttstock stops the piston rod from going too far back.

2. SPADE GRIP, which can be used instead of the rifle buttstock, consists of a single hand grip, made of wood, on the top of which is a screw cap, on the underside of which is attached an oil brush, the body of the hand grip being used as an oil tank. In all other respects it is the same as the rifle buttstock.

5. MAGAZINE

The magazine, which holds forty-seven rounds, and feeds them into the gun as required, consists of the following parts :

1. The magazine pan. This holds the interior spacer ring which is fastened to it by rivets, and holds the interior *separators* ; these are posts which keep apart the front ends of the cartridges.

2. The wall of the magazine is corrugated : on the inside these corrugations hold in position the bases of the cartridges, while on the outside they enable the feed pawl to rotate the magazine, and the right and left stop pawls to prevent too much rotation, or rebound.

3. The magazine centre is made of aluminium, and is fastened to the pan by means of the magazine top plate.

4. The magazine catch which is operated by the magazine catch spring and holds the magazine on the magazine post, once it is in position.

It has a deep turned cut in it to enable two rows of cartridges being held in the magazine, and feed in turn into the feed way.

5. The magazine centre fits over the maga-

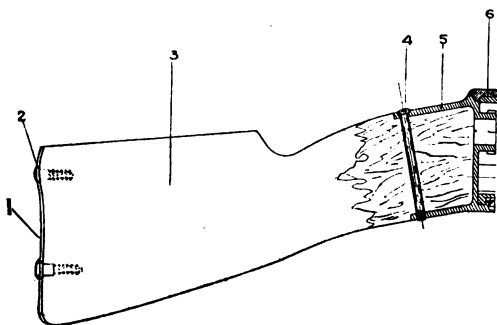
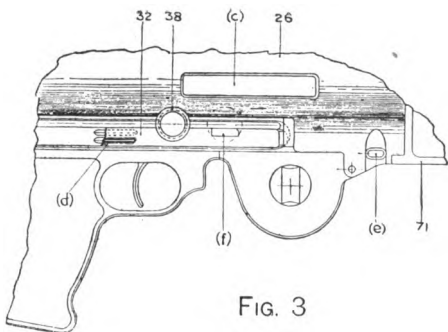
zine post, and is held there by the centre key and spring. It remains stationary while the magazine rotates.

For purposes of testing and filling the magazine, a "filling handle" is supplied.

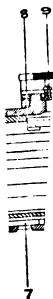
Before filling, the magazine should be turned several times on the filling handle, to see that it rotates freely. If it shows signs of having grit in it, it should be thoroughly washed in paraffin and then oiled.

NUMBERED LIST OF PARTS

1. Butt Plate.	32. Safety R. and L.	59. Return Spring Rivets.	85. Clamp Ring.
2. Butt Plate Screws.	33. Trigger Axis Pin.	60. Magazine Latch Spring.	86. Front Sight.
3. Buttstock.	34. Feed Arm.	61. Pinion Casing.	87. Clamp Ring Positioning Screw.
4. Butt Tang Screw.	35. Feed Pawl.	62. Magazine Latch.	88. Clamp Ring Screw.
5. Butt Tang.	36. Feed Pawl Spring.	63. Centre Key.	89. Barrel Mouthpiece.
7. Butt Catch.	27. Belt.	65. Gear Casing Hinge Pin.	90. Radiator Casing, Front.
8. Back Sight Bed Spring.	38. Cocking Handle.	66. Feed Arm Latch.	91. Sear.
9. Back Sight Bed Spring Screw.	39. Pistol Grip.	67. Magazine Top Plate.	92. Hand Grip.
10. Butt Catch Spring.	40. Cartridge Guide Spring.	68. Body Locking Pin.	93. Oil Well.
11. Back Sight Bed.	41. Sear Spring.	69. Space Ring Rivets (5).	94. Oil Well Cap.
13. Body Cover.	42. Sear Spring Box.	70. Interior Separators (25).	95. Oil Brush.
14. Back Sight Leaf.	43. Magazine Pan.	71. Radiator Casing, Rear, Locking Piece.	96. Spade Grip Butt Tang.
20. Back Sight Slide.	44. Ejector Cover.	72. Rack.	116. Back Sight Elevating Screw.
21. Ejector.	45. Extractors (2).	73. Radiator Casing, Rear.	117. Back Sight Elevating Screw Head.
22. Pistol Grip Side Pieces.	46. Gear Stop.	74. Piston Connecting Pin.	118. Back Sight Elevating Screw Head Pin.
23. Back Sight Axis Pin Washer.	47. Striker Fixing Pin.	75. Piston Connecting Pin.	119. Back Sight Elevating Screw Head Spring.
24. Back Sight Axis Pin.	48. Gear Stop Pin.	76. Barrel.	120. Sear Axis Pin.
26. Body.	49. Gear Stop Spring.	77. Gas Cylinder.	121. Butt Catch Pin.
27. Feed Pawl Spring.	50. Striker.	78. Radiator (Aluminium).	136. Barrel Mouthpiece Spanner.
28. Right Stop Pawl.	51. Cartridge Spacer Ring.	79. Piston.	137. Magazine Filling Handle.
29. Left Stop Pawl.	52. Gear.	80. Gas Regulator Key Stud.	
30. Trigger.	53. Return Spring Casing.	81. Gas Regulator Key.	
31. Feed Arm Actuating Stud.	54. Magazine Top Plate Rivets (6).	82. Gas Chamber.	
	55. Return Spring.	83. Barrel Band.	
	56. Tension Screw.	84. Gas Regulator.	
31x. Feed Arm Actuating Stud Boss.	57. Return Spring Collet.		
	58. Return Spring Centre.		



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ALPHABETICAL LIST OF PARTS

<i>Ref. No.</i>	<i>Name of Part.</i>
76.	Barrel.
83.	Barrel Band.
89.	Barrel Mouthpiece.
26.	Body.
13.	Body Cover.
68.	Body Locking Pin.
37.	Bolt.
7.	Butt Catch.
121.	Butt Catch Pin.
10.	Butt Catch Spring.
1.	Butt Plate.
2.	Butt Plate Screws.
3.	Buttstock.
5.	Butt Tang.
4.	Butt Tang Screw.
40.	Cartridge Guide Spring.
63.	Centre Key.
84.	Clamp Ring.

<i>Ref. No.</i>	<i>Name of Part.</i>
87.	Clamp Ring Positioning Screw.
88.	Clamp Ring Screw.
38.	Cocking Handle.
21.	Ejector.
44.	Ejector Cover.
45.	Extractors (2).
34.	Feed Arm.
31.	Feed Arm Actuating Stud.
31x.	Feed Arm Actuating Stud Boss.
66.	Feed Arm Latch.
35.	Feed Pawl.
36.	Feed Pawl Spring.
85.	Front Sight.
82.	Gas Chamber.
77.	Gas Cylinder.
84.	Gas Regulator.

<i>Ref. No.</i>	<i>Name of Part.</i>
81.	Gas Regulator Key.
61.	Gear Casing.
65.	Gear Casing Hinge Pin.
46.	Gear Stop.
48.	Gear Stop Pin.
49.	Gear Stop Spring.
39.	Pistol Grip.
22.	Pistol Grip Side Pieces Right and Left.
79.	Piston.
75.	Piston Connecting Pin.
72.	Rack.
78.	Radiator.
90.	Radiator Casing, Front.
74.	Radiator Casing, Rear.
71.	Radiator Casing, Rear, Locking Piece.

<i>Ref. No.</i>	<i>Name of Part.</i>
55.	Return Spring.
53.	Return Spring Casing.
57.	Return Spring Collet.
59.	Return Spring Rivets.
32.	Safety R. and L.
91.	Sear.
120.	Sear Axis Pin.
41.	Sear Spring.
42.	Sear Spring Box.
28.	Stop Pawls, R. and L.
27.	Stop Pawls Spring.
50.	Striker.
41.	Striker Fixing Pin.
m.	Striker Post.
56.	Tension Screw.
30.	Trigger.
33.	Trigger Axis Pin.

PLATE II

BARREL GROUP AND PISTON ROD

- 76. Barrel.
- 89. Barrel Mouthpiece.
- 83. Barrel Band.
- 78. Radiator.
- 90. Radiator Casing, Front.
- 74. Radiator Casing, Rear.
- 71. Radiator Casing, Rear, Locking Piece.
- 136. Barrel Mouthpiece Spanner.
- 84. Gas Regulator.
- 81. Gas Regulator Key.
- 86. Front Sight.
- 88. Clamp Ring Screw.
- 87. Clamp Ring Positioning Screw.
- 85. Clamp Ring.
- 77. Gas Cylinder.
- 79. Piston.
- 75. Piston Connecting Pin.
- 72. Rack.
- 50. Striker.
- 47. Striker Fixing Pin.
- m. Striker Post.
 - e. Bent.
- 6. Rear Mounting Band.

PLATE III

BODY GROUP AND RETURN SPRING AND TRIGGER MECHANISM

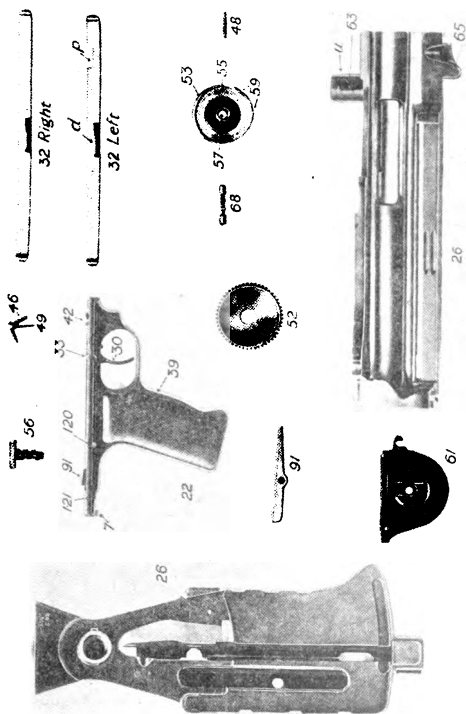
- 26. Body.
- 11. Magazine Post.
- 63. Centre Key.
- 32. Right and Left Safety.
- 91. Sear.
- 65. Pinion Casing Hinge Pin.
- 68. Body Locking Pin.

GEAR AND RETURN SPRING

- 56. Tension Screw.
- 46. Pinion Stop.
- 49. Pinion Stop Spring.
- 61. Pinion Casing.
- 52. Pinion.
- 55. Return Spring.
- 57. Return Spring Collet.
- 53. Return Spring Casing.
- 59. Return Spring Rivets.
- 48. Pinion Stop Pin.

PISTOL GRIP AND TRIGGER MECHANISM

- 121. Butt Catch Pin.
- 7. Butt Catch.
- 91. Sear.
- 120. Sear Axis Pin.
- 33. Trigger Axis Pin.
- 42. Sear Spring Box.
- 30. Trigger.
- 39. PISTOL GRIP.
- 22. Pistol Grip Side Pieces R. and L.



GUN PARTS: BODY GROUP, MAINSPRING, AND TRIGGER MECHANISM

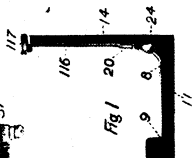
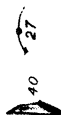
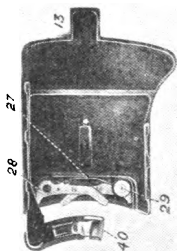
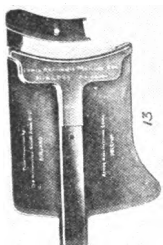
PLATE IV

FEED MECHANISM, BOLT, EXTRACTORS, AND EJECTOR. BACK SIGHT

- 37. Bolt.
- 45. Extractors (2).
- 31. Feed Arm Actuating Stud.
- 31z. Feed Feed Arm Actuating Stud Boss.
- 34. Feed Arm Finger.
 - g. Spring Stud.
 - r. Axis Stud.
 - p. Feed Way.
- 35. Feed Pawl.
- 36. Feed Pawl Spring.
 - s. Projection of Feed Arm.
- 66. Feed Arm Latch.
- 21. Ejector.
- 44. Ejector Cover.
- 40. Cartridge Guide Spring.
- 27. Feed Pawl Spring.
- 28. Right Stop Pawl.
- 29. Left Stop Pawl.
- 13. Body Cover.

BACK SIGHT.

- 9. Back Sight Bed Spring Screw.
- 8. Back Sight Bed Spring.
- 11. Back Sight Bed.
- 24. Back Sight Axis Pin.
- 23. Back Sight Axis Pin Washer.
- 20. Back Sight Slide.
- 14. Back Sight Leaf.
- 116. Back Sight Elevating Screw.
- 117. Back Sight Elevating Screw Head.

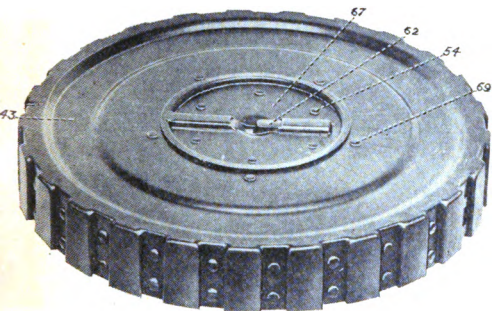


GUN PARTS : FEED MECHANISM, BOLT, EXTRACTORS, AND EJECTOR

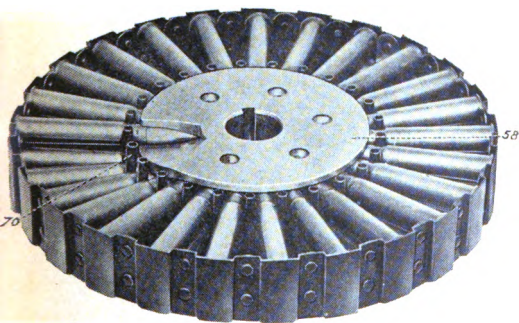
PLATE V

The Magazine (Plate V) is an assembled unit composed of the following parts:

- 51. Cartridge Space Ring.
- 70. Interior Separators (25).
- 58. Magazine Centre.
- 62. Magazine Latch.
- 60. Magazine Latch Spring.
- 43. Magazine Pan.
- 67. Magazine Top Plate.
- 54. Top Plate Rivets (6).
- 69. Spacer Ring Rivets (5).



MAGAZINE, TOP VIEW



MAGAZINE, BOTTOM VIEW

PLATE VI

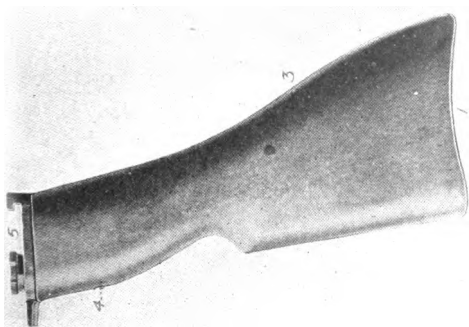
BUTTSTOCK GROUP

The Rifle Buttstock is a single assembled piece composed of:

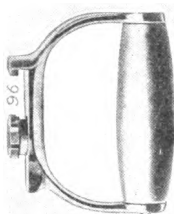
1. Butt Plate.
2. Butt Plate Screws (2).
3. Buttstock.
4. Butt Tang Screw.
5. Butt Tang.

The Spade Grip is for use when preferred to ordinary Buttstock.

92. Hand Grip.
93. Oil Brush.
93. Oil Well.
94. Oil Well Cap.
96. Spade Grip Butt Tang.
136. Magazine Filling Handle.



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ACCESSORIES : BUTTSTOCK AND MAGAZINE FILLING HANDLE

CHAPTER III

TO LOAD THE GUN

PLACE a full magazine on the magazine post, with the catch to the right, and draw back the cocking handle.

If the trigger is pressed, the gun will fire rapid.

Single shot firing may be done by pressing and rapidly releasing the trigger.

TO UNLOAD

1. Remove magazine. This leaves one cartridge in the feed way.

Pull trigger and fire last round, pull trigger again.

2. If the last round must not be fired, remove magazine, take hold of cocking handle, pull trigger and ease cartridge forward until it is in the bolt way. Pull back cocking handle, raise safety. Push cartridge from bolt way with bullet point.

THE BACKWARD AND FORWARD MOVEMENT

The mechanical or automatic working of the gun may be divided under two headings :

- I. The Forward Movement.
- II. The Backward Movement.

I. THE FORWARD MOVEMENT

Assuming that the gun is in the ready-to-fire position with "cocking handle" pulled back.

1. TRIGGER.—The *trigger* is pulled depressing the *nose of the sear*, thus firing it from the bent on the piston.

2. RETURN SPRING.—This enables the *return spring* to unwind itself, by driving forward the piston, by the pinion acting on the rack.

3. BOLT.—The left side of the *striker post* bearing upon the left side of the curve in the cam slot, drives the bolt forward.

4. FEED ARM.—The *feed arm* is immediately moved from left to right by the feed arm actuating stud boss working under the finger of the feed arm.

5. FEED PAWL.—This causes the feed pawl to slide over and engage in another corrugation in the magazine.

6. LEFT STUD.—The left stud also withdraws the right stop pawl.

7. NEXT CARTRIDGE.—The top of the fore part of the bolt, striking the bottom of the base of the cartridge, forces it down into the feed way, assisted by the cartridge guide spring, and as the bolt moves forward into the chamber.

8. EJECTOR.—The fore part of the bolt knocks against the fore part of the ejector, knocking it in, and causing the rear part of the ejector to protrude.

9. CRUCIFORM LUGS AND LOCKING RECESSES.—When the cruciform lugs reach the locking recesses, the curve in the cam slot enables the striker post to turn the bolt one-eighth turn to the right, thus locking the bolt.

10. EXTRACTORS.—The extractors spring over the rim of the cartridge.

11. STRIKER.—The striker is now in the straight part of the cam slot, and travels the last $1\frac{1}{2}$ in. (the bolt being stationary)

and fires the cap, still driven by the return spring.

II. BACKWARD MOVEMENT

Assuming that the cartridge has just been fired :

1. GAS.—The powder gases follow the bullet down the barrel until 4 in. from the barrel mouthpiece. Part of them escape through (1) the gas port into (2) the gas chamber into (3) the gas regulator, where any solid body is deposited, back into (4) the gas chamber and (5) into the gas cylinder, where hitting against the cup-shaped front end of the piston they drive it back.

2. RETURN SPRING.—The piston in going back winds up the return spring, the rack engaging on the pinion.

3. BOLT.—The striker post travelling back $1\frac{1}{2}$ in. in the straight part of the cam slot, bears with its right side on the right side of the curve on the cam slot, rotating the bolt to the left, and bringing the cruciform lugs opposite the cruciform ways, and freeing them from the locking recesses.

From now onwards, the bolt takes part in the backward movement.

4. **EXTRACTORS.**—The extractors withdraw the cartridge case from the chamber.

5. **EJECTOR.**—The rear end of the feed arm actuating stud, knocking in the rear end of the ejector, causes the front end of the ejector to knock against the cartridge case, sending it from the extractors through the ejector way in the body.

6. **FEED ARM, FEED PAWL.**—Directly the bolt moves back, the feed arm actuating stud boss moves the feed arm from right to left, causing the feed pawl to rotate the magazine (clockwise), and to place another cartridge under the cartridge guide spring.

7. **LEFT STUD.**—The left stud, which is also on the feed arm, disengages the right stop pawl, thus allowing it to stop the magazine from rotating too far.

8. The piston reaching its backward position, the nose of the sear engages in the bent on the piston unless the trigger is pressed, in which case "rapid fire" will continue.

CHAPTER IV

STRIPPING AND ASSEMBLING THE GUN

THE gun can be stripped with the cocking handle in any position. It is best that the magazine should be taken off, the chamber cleared, and the cocking handle put in the forward position to start with.

To STRIP

1. Push forward the butt latch with the point of a punch, at the same time give the buttstock a twist to the left. It is now possible to withdraw the buttstock by pulling it to the rear.

This removes the buttstock group, which need not be stripped further.

2. Pull back the trigger and slide back the pistol grip until clear of the body, thus removing the trigger mechanism.

3. Pull down the pinion casing so that it is clear from the rack. It will usually fall down of its own accord.

4. Remove the body cover by sliding it to

38 STRIPPING AND ASSEMBLING THE GUN

the rear, until it is clear of the locking projections.

5. Pull back the cocking handle, until it reaches the rear of its slot way, and then pull it out.

6. Remove the feed arm, by forcing back the feed arm latch with a point of a punch, and removing it from the magazine post.

7. Draw out the piston rod, and the bolt which will be on the striker post. Take bolt off striker post.

8. With the point of a punch force back the body locking pin and give the body a turn to the left.

9. Unscrew the body from the barrel.

10. Unscrew the clamping screw by means of gas regulator key. Remove clamp ring and front radiator casing.

[The body locking pin may be removed, and the gear casing unhooked.]

11. Unscrew and remove gas regulator.

12. Slide off (to the rear) the rear radiator casing. A slight tap may be necessary.

13. Unscrew the gas cylinder from the gas chamber; if stiff, the piston rod may be re-inserted and used as a key.

14. Unscrew gas chamber; a tool is provided for this.

15. By unscrewing the barrel mouthpiece

slightly and dropping barrel and radiator on to a block of wood (barrel mouthpiece downwards), it is possible to remove radiator from barrel. The radiator slides down towards the muzzle. The barrel being tapered, the barrel band slides with it.

This should not be done more often than absolutely necessary.

DETAILED STRIPPING

Body

Back Sight.—This can be removed by unscrewing and withdrawing the *bed spring screw*.

Ejector.—Push the point of a punch into the hole in the rear end of the ejector cover, and lift cover up and push back. The ejector can now be taken out.

In replacing ejector, it is most important that the cover should be right home, otherwise it projects and prevents the feed arm finger from going right over to the left, thereby stopping the cocking handle from coming right back.

Safety Slides can be forced from the side of the body with a punch point.

Return Spring

1. Push up gear stop, thereby allowing

spring to unwind itself by turning the pinion wheel.

2. Unscrew and take out tension screw.

3. Shake pinion from pinion casing.

4. Shake spring case from pinion.

5. The return spring may be removed with the point of a punch.

Pinion stop should not be stripped ; this can be done in case of necessity by driving out the pinion stop pin.

PISTOL GRIP.—Drive out trigger axis pin and sear axis pin, by means of a punch.

Draw back and remove *trigger*. Remove plunger, spring, and *gear*.

Butt Latch.—Drive out butt latch pin and remove butt latch and butt latch spring.

In the ordinary course of events the pistol grip does not need to be stripped.

In assembling, care should be taken to see that the axis pins are driven right home, otherwise the pistol grip will not slide on to the body.

THE STRIKER may be removed from the striker post by driving out the striker pin.

Bolt

Feed Arm Actuating Stud.—Unscrew and remove from bolt.

Extractors.—These are sprung into position. To remove, place point of punch under groove and push away from centre of bolt, at the same time pulling forwards.

Piston.—The piston head is fastened by a riveted pin to the piston rod. In case of necessity this can be driven out and piston head removed.

ASSEMBLING

The gun should be assembled, the parts being put together in the reverse order to that in which they are stripped.

The following points require attention :

1. The barrel band must be in proper position with its hole over the gas port in the barrel.

2. The gas chamber must be screwed so that when the gas cylinder is screwed in, it is true with the barrel.

3. The body locking pin should be right forward. This can easily be done by raising the gear casing and letting it fall again.

4. The cocking handle having been inserted the piston should be pushed right home, the teeth of the pinion should then be engaged, and the pistol grip pushed right home.

CHAPTER V

TENSION OF THE RETURN SPRING

THE tension of this spring has got to be sufficient to counteract the pressure of the powder-gases against the piston when it is in its backward position and to drive it forward again.

The ideal tension is of course that which exactly balances the pressure of these gases. Messrs. Lewis, Ltd., state that 12-14 lb. is the correct tension.

The gun is found to fire very well with the tension at $10\frac{1}{2}$ lb. however. This is when the small hole of the gas regulator is used. When the large hole is in use, a greater tension will be required.

If the tension is too small miss-fires will occur, and the back end of the piston rod will hammer too hard against the tang of the buttstock.

If the tension is correct, the bolt and rod barely touch the tang.

If the tension is slightly too high, the gun will fire faster than usual.

If the tension is much too high, the force of the gas will not be sufficient to drive back the piston far enough to allow of the base of the next cartridge being engaged by the front of the bolt.

TO WEIGH THE TENSION

Take the spring balance issued with the gun and fasten one end round the cocking handle. Hold the other end in one hand, and pull the cocking handle backwards and forwards once or twice. Then retain cocking handle about 1 in. from front position, and read the spring balance.

TO INCREASE TENSION

Remove buttstock.

Slide pistol grip back a short distance. Hold pinion casing up firmly, so that pinion engages in rack, and pull back cocking handle.

Let pinion case drop.

Push forward cocking handle.

Push up pinion case.

Engage pistol grip.

If spring tension is correctly increased, replace buttstock.

TO DECREASE TENSION

Remove buttstock.

Draw back pistol grip a short distance.

Let pinion case drop.

Draw back cocking handle.

Raise pinion casing.

Push home pistol grip.

This will release pinion stop and cause spring to unwind and carry home the piston rack.

If decrease is sufficient, replace buttstock.

N.B.—For instructional purposes the return spring tension should be as light as possible when not on the range, as the constant firing of the gun without anything in the chamber is very apt to wear out the striker, if the tension is high.

CHAPTER VI

GAS REGULATOR

UNDER ordinary circumstances the small hole of the gas regulator should be used (*i.e.* the "S" on the gas regulator turned to the rear).

If after a long period of firing the gun begins to fire slower than usual, at the first opportunity the magazine should be removed, and the gas regulator taken out and cleaned, also a single shot should be fired. This will clear the gas port.

Firing should be resumed with the large hole of the gas regulator turned towards the rear.

CHAPTER VII

POINTS BEFORE AND AFTER FIRING

POINTS BEFORE FIRING

1. Thoroughly *overhaul* gun to see that no part is deficient and that the *mechanism* works freely.

Specially look at :

- (a) Striker post and bolt cam slot.
 - (b) Tap top of feed arm finger to see it is not bent.
 - (c) Pinion pawl axis pin—must be in.
 - (d) Ejector cover—must be down.
2. See that :
- (a) Barrel is clean.
 - (b) Barrel mouthpiece is hand-tight.
 - (c) Small hole in gas regulator is to the rear.
3. Slightly oil :
- (a) Bolt and piston way.
 - (b) Teeth of pinion and piston racks.
 - (c) Striker post, bolt cam slot, and F.A.A.S. screw.
 - (d) Underside of ejector.

- (e) Feed arm latch, stop pawls, C.G.S., and F.A.A.S. groove.
- (f) Press trigger and oil knuckle joint.
- (g) The two cross ribs on underside of body cover.

Important

Piston Rings.—Place slightly oiled rag over left hand, hold piston by rear end in right hand, gently place piston rings on oily rag and turn piston over.

4. Weigh and adjust return spring (about 12 lb.).

5. See that mounting is firm.

6. Examine magazines and ammunition.

7. See that spare parts and oil reserve are handy.

Never put oil in cylinder or on piston head cup.

If possible always keep bottle of paraffin in the spare parts case for cleaning cylinder mop.

POINTS DURING FIRING

1. During a temporary cessation of fire re-oil slightly as in Points before Firing.

2. Replace a partly emptied magazine with a full one.

3. Examine the mounting to see that it is firm.
4. See that empty magazines are refilled without delay.

POINTS AFTER FIRING

1. Unload.
2. Oil parts as in Points before Firing.
3. Clean cylinder and piston head cup with paraffin.
4. Ease the return spring.
5. Clean the bore daily for a week.

These points are of the very greatest importance, and neglect of them unnecessarily increases the number of stoppages.

Position of Cocking Handle	Immediate Action	Probable Cause
1. Forward.	<p>1. Try to rotate magazine. (a) If free, change it. (b) If fixed, pull back cocking handle. 1. Round ejected. 2. No round ejected.</p> <p>2. If a 2nd misfire, <i>i.e.</i> if on pressing trigger guns does not fire. (a) Change magazine and piston rod. (b) If no round ejected, examine for broken pawls and springs.</p> <p>3. If cocking handle will not move, change magazine.</p>	<p>1. Empty. (b) 1. Miss fire. 2. Space in magazine.</p> <p>2. (a) Broken striker. (b) Weak or damaged pawl springs or pawls.</p> <p>3. Damaged magazine.</p>
2. Over thumb piece, or less than cartridge length. Prolonged.	<p>1. Pull back cocking handle. If it occurs again, oil up and turn gas regulator.</p> <p>2. If cocking handle won't come back, use strap or cord. Cocking handle fixed.</p>	<p>1. Hard extraction. Friction.</p> <p>2. Hard extraction. Bottom broken extractor.</p>
3. Back behind thumb piece.	<p>1. Examine ejection opening. (a) If clear, pull cocking handle and continue. (b) If cocking handle does not go forward, change cartridge guide spring. (c) If cocking handle moves easily, change return spring. (d) If cocking handle won't move, change magazine.</p> <p>2. (a) If obstruction in opening or chamber, clear it. Look for damaged extractors or ejector.</p>	<p>1. (a) Slight fault in feed. (b) Broken cartridge guide spring. (c) Broken return spring. (d) Damaged magazine.</p> <p>2. (a) Broken extractor. Broken ejector.</p>

POSSIBLE CAUSE OF STOPPAGES—TEMPORARY AND PROLONGED

- | | |
|---|--|
| <p>1. In forward position.
 Bullet left in "lead" (nearly forward position).
 Extraction hard.
 Feed pawl worn or broken.
 Gas cylinder foul.
 Gas regulator turned through key lost.
 Gas regulator and chamber foul.
 Magazine empty, damaged, or magazine space empty.
 Miss fire.
 Pawl springs broken or weak.
 Rebound pawl worn or broken.
 Return spring very weak.
 Striker worn or broken.
 Stop pawl broken.</p> | <p>2. Over thumb piece on safety catch.
 Cartridge badly bulged.
 Case separating.
 Extraction hard.
 Gas cylinder foul.
 Gas regulator turned through key lost.</p> <p style="text-align: center;"><i>Various Positions</i></p> <p>Broken return spring.
 Piston rod broken.
 Striker post broken.</p> |
| | <p>3. Behind thumb piece on safety catch.
 Bullet bearing against front of cartridge slot in body.
 Cartridge guide spring broken, or weak, or faulty action.
 Case not ejected, possibly through hard extraction.
 Ejector broken.
 Extractors broken, or damaged magazine.
 Return springs broken.
 Pawls springs weak.
 Stop pawl worn.</p> |

NOTES

1. The cocking handle can stop in every position for a broken return spring.
2. After remedying every stoppage, relay again before firing.
3. The majority of stoppages are caused by neglect of points before firing. These must most carefully be attended to.
4. Never put too much oil in the gun, especially in cold weather; it works better with very little. Never put oil in the cylinder or near piston head cups.
5. The rectification of stoppages should be practised at night as the men get proficient.
6. If the gun has to be partially stripped to clear the stoppage, care must be taken not to alter the tension of the return spring.
7. If the gas regulator key has been lost, the gas regulator may be prevented from turning by inserting a piece of wood in the slot and securing it to the radiator casing with string.
8. Firing a round with the gas regulator removed is an efficient means of clearing the gas vent in the event of its being foul.
9. If the cord or strap is required very often, it is probably due to overheating of the gun, which must be allowed to cool. About twelve magazines can be fired without waiting for the gun to cool.
10. Extractors usually break through friction of rusty seatings and dirt underneath them.
11. If the cocking handle frequently stops in the rear position and it cannot be traced to any of the probable causes," examine the cartridge through the ejection opening without pulling back the cocking handle. If the bullet is bearing against the front of the cartridge slot in the body, the ammunition is too long. If the front of the cartridge slot is sloped downwards with a file, this stoppage will not occur.
12. Badly bulged cartridge, sufficient to stop the gun, should never escape notice when filling magazines. If one did get in, the cocking handle would stop before getting right forward, its position varying according to the damage to the cartridge. The cocking handle should be pulled back with a strap or cord.

CHAPTER IX

GUN DRILL FOR THE LEWIS AUTOMATIC MACHINE GUN

PART I

GUN Drill is a most important item in the training of a Machine Gun Section. It teaches discipline and steadiness, which may be of the greatest value in an emergency, and at the same time makes the Section accustomed to the "handling" of the gun.

Attention should be paid to both smartness and correctness in drill; without these two qualities the gun drill of a section has very little value.

It is important that the following points should be observed:

- (1) *No. 1* must repeat all orders.
- (2) All numbers working with the gun must keep perfectly still until the command "easy" is given.

A man lying still is difficult to see, where

a man moving about may be seen with the greatest of ease.

The sights should always be adjusted with the left hand, as this preserves the balance of the firer.

DRILL WITH THE "SPADE MOUNTING"

MOUNTING GUN

COMMAND. — "*Take Post.*" — (The gun should be attached to the spade mounting beforehand.)

No. 1 lies on the left of and beside the gun and mounting.

No. 2 lies 3 yards on the left of the gun with a magazine.

No. 3 lies to the rear of the gun with a case of magazines.

Directly they have taken up their positions they should number again.

Nos. 2 and 3 look and see that all is correct and report "all correct" to No. 1, who having looked round his gun shouts "up."

No. 2 holds up his hand.

"*Mount Gun.*"—No. 1 grips the spade mounting and the small of the buttstock and doubles into position, and lies down, placing the buttstock to his shoulder and holding it

there with the left hand, while his right is on the pistol grip.

Directly he is ready he raises his tangent sight, and when magazine is on pulls back the cocking handle.

No. 2 doubles up, and lies down on the left of the gun.

Directly No. 1 raises the tangent sight he places the magazine on the magazine post (catch to the right).

No. 3 doubles up, and places a magazine box in front of No. 2, in his reach. And then doubles back and assumes a prone position to the rear and to a flank.

Directly all is ready to open fire No. 1 shouts "up" and No. 2 holds up his hand, as a signal to the machine gun officer.

No. 2 watches the machine gun officer for signals.

"*Load.*"—No. 1 repeats the order and pulls back the cocking handle and raises tangent sight—which he sets on receiving directions as to the range.

"*At Aiming Mark (or Target).*"—No. 1 repeats and lays the gun on the target ready to fire. When he is ready he informs No. 2, who holds out his arm horizontally.

"Cease Fire."—No. 2 taps No. 1 on the shoulder, and No. 1 takes his finger off the trigger and raises the safety catch.

"Dismount Gun."—No. 2 releases the magazine catch and removes magazine, and doubles back with it to his former position, and lies down.

No. 1 taps down his sight while No. 2 removes the magazine.

He then doubles back with gun to his former position and lies down.

No. 3 doubles up and takes back magazine case to his old position.

Directly all are back correctly No. 1 shouts "up" and No. 2 holds up his hand.

"Change Round."—No. 1 falls out.

No. 2 takes No. 1's place.

No. 3 takes No. 2's place.

No. 4 takes No. 3's place.

Directly they are down they number off, and carry on as in "Take Post."

"Action."—Same as "Mount Gun" only No. 1 is given the range and object first, and puts his sights to correct range before doubling up.

“ Out of Action.”—Same as in *“ Dismount Gun.”* When the position in the rear is reached the gun is unloaded without firing.

PART II

Orders.—The range should be given, then some outstanding feature in the landscape, or on the target, and lastly the actual objective. (Vide Chapter XII.)

On a practice target *“ Range 700, left hand group of skirmishers, left hand figure.”*

HORIZONTAL TRAVERSE

This method of fire is used for sweeping a target of some considerable depth, and may be done for practice on an ordinary practice target at 25 yards.

On the command *“ Traverse to right ”* or *“ left ”* No. 1 fires a burst, and then moves his shoulders and fires another burst. For practice purposes he should fire six bursts, which means that he will make five movements.

At 25 yards each of these movements should be equivalent to 2 in., which at 100 yards would be 8 in., and at 600 yards would be 4 ft.

At this range, allowing for cones of fire (vide diagram page 82), the whole target should be properly swept. This also applies to 1,000 and 1,500 yards.

At 25 yards the first burst will hit a figure, the second a gap, the third a figure, and so on until the sixth burst will hit the third gap from the figure where he started.

No. 2 should count the bursts, and when six have been fired he should tap No. 1 on the shoulder to tell him to "cease fire."

No. 1 should check the correctness of his traversing by glancing through his sight.

SWINGING TRAVERSE

In this method of fire, the gun is used in a similar way to a water hose pipe.

It may be used against an enemy advancing in massed formation, or at a close range.

No. 1 sweeps down the length of the target offered with or without interruption.

For practice purposes two-thirds of a practice target should be traversed. This can be done without moving the body enough to make a movement of the elbows necessary.

PART II

THE HANDLING OF THE GUN

CHAPTER X

**CHARACTERISTICS OF THE MACHINE
GUN**

I. THE Lewis Gun mounted upon a "spade mounting" cannot be said to have the full advantages of the "fixed platform" possessed by the Vickers Gun mounted upon a tripod.

The "spade mounting" gives the gun a certain steadiness which is not possessed by a rifle, and therefore the danger of the accuracy of fire being disturbed by excitement, etc., is to a certain extent reduced.

The gun cannot be used for overhead, indirect, or accurate night firing, as can the Vickers Gun.

The steadying of the gun by the spade mounting will tend to produce (a) more concentrated fire than can be obtained from

a number of rifles, (b) a zone of fire of great depth.

The gun is, therefore, suitable for employment against targets possessing considerable depth.

Close Grouping of Fire.

1. This enables a steady fire to be suddenly concentrated on any point, causing great surprise to the enemy, and often causing panic.

2. Owing to this the fire can easily be observed by the splash of bullets on the ground.

II. *The rapid application of a large volume of fire* at any target is possible with the Lewis Gun.

(a) The gun can be used to sweep down a line of attackers.

(b) Direction and control of fire is easier for its volume than rifle fire would be. It is easier to make four men pick up a target and cease fire than it is 200 men with rifles.

The gun is therefore very useful in an emergency, against a sudden attack, or to batter down any small target, *e.g.* an enemy machine gun met in an assault.

III. The gun occupies far less space than the riflemen equivalent to a machine gun would do. It can thus be used in :

1. Villages, houses, narrow spaces, such as passages in towns, or roads.
2. Enfilade fire.
3. This characteristic makes the gun difficult to locate.

IV. The gun can be quickly traversed.

1. The gun can quickly change from one target to another.
2. The gun is of great service against an enveloping attack.

V. *Invulnerability.*

This is a most important characteristic. If casualties occur, another member of the section can take the injured man's place. If many casualties occur, one man can continue to fire the gun.

The greatest care should be taken to avoid unnecessary casualties. Good machine gunners are not easily or quickly trained.

VI. *Mobility.*—The gun is easily moved from place to place, and can follow infantry closely in an attack.

The guns can be kept in the background, and used as a mobile reserve in case of hostile attack.

VII. The gun is suited only for short bursts of rapid firing, and should only be used where an excellent target is offered.

VIII. The gun is air-cooled and is therefore liable to become *overheated*, and not more than 12 magazines can be fired in succession. The magazine only holds 47 rounds of ammunition, so that continuous bursts of fire cannot be fired as with the Vickers with its belts of 250 rounds.

If the gun is overoiled it will smoke; this may disclose its position. It is liable to accidental cessation of fire due to stoppages through—

(a) Mechanical breakages or faulty ammunition, which are unavoidable.

(b) Carelessness on the part of the firer.

IX. The noise of firing is apt to make it easy to more or less locate the gun.

Thus good cover is necessary, also good alternative positions should be chosen before firing, and *not after*.

For this reason the ground near the machine guns should be explored, if possible by the machine gun officer, in order that he may know his way about in case of a retreat being necessary.

CHAPTER XI

ORGANISATION AND ALLOCATION OF DUTIES

THE system of organisation upon which Lewis Guns are worked at present is as follows :

A detachment of two guns is attached to each company, and, in addition to the company detachments, each battalion has two more detachments, which may be used in places where they are needed or kept in reserve. They may also be used to relieve the company detachments when necessary.

Each gun has a team of six men, and an N.C.O. is in charge of each detachment.

1. *The Officer*.—Each battalion has a Lewis Gun officer, whose duty it is to supervise the working of the guns, and to be responsible for the training and discipline of the detachments.

When the guns attached to the companies are in action, they are under the control of the company commanders. The Lewis Gun officer should have control of the two de-

tachments which are not attached to the companies, and should make such use of them as he thinks fit from his knowledge of the tactical situation. He will also have to organise the supply of ammunition, and assist the company commanders with advice as to the use of their guns.

When not in action, much of the officer's time is spent in training reserve gunners in order to keep the detachments up to full strength. The choice of gunners should be most carefully made. Men of intelligence, who are good shots, of good physique, and, if possible, with mechanical knowledge, should be chosen.

2. *The N.C.O.'s* with each company are responsible for the working of the guns in their detachments and for the carrying out of orders. These N.C.O.'s should be chosen very carefully, as upon their initiative and good sense much may depend.

THE GUN TEAM

1. *No. 1*, who will probably be a lance-corporal, fires the gun in action, and is responsible for its care and cleaning. He carries the gun and four magazines into action, and when in action should repeat all

orders given him, and observe and control his fire in order that it may be used to the greatest advantage.

2. *No. 2* brings up the spare parts, and two bags of magazines. He must take the place of *No. 1* should he become a casualty.

3. *No. 3* brings up ammunition, and is responsible for the supply of ammunition to the gun.

4. *Nos. 4, 5, and 6* are employed as ammunition carriers and in the filling of magazines; they should be ready to form a relief to *Nos. 1, 2, and 3*.

It is clear that in the event of casualties occurring, every member of the gun team should be able to do the work of any other member. It is therefore of the utmost importance that the standard of training should be high, and that every member of the team shall understand the tactical situation.

It is wise to make each member of the team do the work of each number in turn, in order that he shall not fail if he is called upon to do another man's work. For this reason many officers keep a register, and make their men do different duties every day.

CHAPTER XII

INDICATION AND RECOGNITION OF TARGETS

MUCH practice is necessary, both for the machine gun officer in indicating the target at which he wishes his guns to fire, and also to the gun numbers, in recognising and quickly picking up these targets.

For elementary training, a Hill-Siffkins target on the parade ground is all that is required. But later the section should be taken out, if possible, to some likely machine gun position in the country.

1. In either case, any clear and outstanding target should be given, without any delay, or reference to other features of the landscape.

2. In the case of less outstanding targets, it is found best to pick some outstanding feature of the landscape, and give the position of the target as relative to that.

If time allows, two or three outstanding features in the landscape may be chosen for future reference. Three is the maximum

number under all ordinary conditions, as more than this is apt to lead to confusion.

The eye may be guided from these reference points to less obvious targets.

Two methods are usually used :

1. *The Clock Method*.—A clock face is imagined to be set on the base of the reference point, and any other object given by the hour at which it stands on the clock face.

2. *The Finger Method*.—Where targets are directly to right, left, above or below reference points, they may be indicated by holding the left arm at its full length and holding the fingers vertically—one finger should be set against the reference point, and the number of fingers necessary to reach the target required should be counted.

For objects above or below the reference point the fingers should be held horizontally.

This method is necessarily rough and inaccurate.

Any hard-and-fast rule for the indication of targets cannot be given, as officers and N.C.O.'s must be largely guided by circumstances.

The orders given for the indication of targets should be as short and concise as possible.

68 INDICATION AND RECOGNITION OF TARGETS

The Range should be given first, as No. 1 can put up his sights to this and register the range, and be no longer troubled by this question. It also acts as some indication of the distance of his target.

In the case of an obvious target, the indication order might be :

(A) "Range 500. Left front. Bend in road."

Or :

(B) "Range 1,000. Right front. Bottom of line of trees, left-hand edge."

For less obvious targets :

(C) "Range 700. Church (indication point), seven o'clock, corn-field, hedge on far side. Left-hand corner."

Or :

(D) "Range 900. Cottage, three fingers right, *bushes*. Right edge."

In all cases the actual target should be given last.

Much practice at this is necessary in order to train the men to recognise targets quickly and without mistakes.

CHAPTER XIII

RANGE CHARTS

WHERE time permits the ranges of various objects in the landscape should be taken anticipatory to the appearance of an enemy.

These readings should be carefully noted down, in a clear and concise form, for the future use of the commanders present.

As these *Range Charts*, as they are called, will not be used by the man who makes them, but by another, it is most important that they should be *made out very clearly to prevent any possible confusion*.

Range Charts may be made out by the use of large-scale maps, but these will probably not be so accurate as those done by an accurate range finder.

In the first stages of training a great number of Range Charts should be made. Much valuable practice may be obtained in the barrack square, making Range Charts of landscape targets, and filling them in with imaginary ranges.

There are two types of Range Charts :

- I. Defensive.
- II. Offensive.

I. THE DEFENSIVE RANGE CHART

In this type of Range Chart, the man in charge of the instrument will carefully examine the landscape, and will notice such objects in it as are likely to be passed by the enemy or used by them for taking cover, in making an attack upon his position.

He will then take a piece of paper, or even better a card, and will draw a line from himself in the direction of the most outstanding feature in the landscape, *e.g.* PA in Fig. 1. This line will be drawn double, and will act as a guiding or "sighting" line.

He will then draw his base, which will represent the line of his own line of defence.

He will then draw other lines in the direction of the various features in the landscape, whose ranges may, in his opinion, be of use in case of an attack ; *the guiding line should always be kept in the line between himself and the original object A*, and will thus assist in the "setting" of the chart.

In order to avoid confusion he should

letter these objects, and should write in the margin to what the letters refer. (*Vide* Fig. 1.)

He will then take the ranges of the various objects, and will write the ranges found against the letters at the ends of the lines. (*Vide* Fig. 1.)

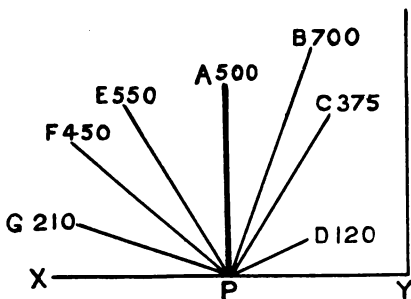


FIG. 1.

REFERENCE.

- A = LEFT GABLE FARM-HOUSE.
- B = HAYSTACK.
- C = LEFT EDGE THATCHED COTTAGE.
- D = CROSS ROADS.
- E = TELEGRAPH POSTS.
- F = LEFT EDGE LINE OF POPLAR TREES.
- G = RIGHT CORNER WOOD.
- P = POSITION.
- P = 1st R in RUSHMOOR. N.N.W. of CROSS
- ROADS — to — and — to —
- Date . . .
- Signature . . .

All writing should be in Block Capitals. If a map is available, the point on the map at which the man is should also be noted down, and the direction of his lines should be noted with reference to the points of the compass.

The base line XY will be drawn to represent the line of the defending force.

Having completed his Range Chart, the man should then sign and date it.

The completed Range Chart for Defensive Purposes will then appear as in Fig. 1.

Having completed the chart, he should then take it to the officer in charge, and if necessary copies should be made for fire unit leaders.

II. OFFENSIVE RANGE CHARTS

Offensive Range Charts are used where an attack is intended.

The ground over which the attack will be made must necessarily be studied most carefully, as in a great many cases the distance to be covered before the objective is reached will be such that it will be unwise, and in some cases impossible, to carry out the attack in one rush.

Rather, it will be necessary to make a series of rushes, and between these rushes a

halt will have to take place, in order to give the attackers an opportunity to rest.

Such rest should, wherever possible, be taken under cover, while the rifles of the attackers should be used as much as possible to obtain a superiority of fire over the enemy.

In order to obtain this superiority of fire, it is necessary that the fire should be *accurate*, and this accuracy will be greatly assisted if the attackers—

1. Know the range of the enemy, as they arrive at each successive halting place.
2. Are covered as far as possible from enemy fire, both from rifles and artillery.

Therefore before the attack is made the *ground* must be carefully studied with a view to the discovery of intermediate cover.

A sketch should be made of the ground, and the ranges of such resting points and of the objective taken.

These ranges should be written on the right-hand side of the sketch as in Fig. 2.

When these ranges have been taken, we know the distances of the various resting points from the original starting place.

But in the rush forward, as each successive point is reached, its range not from the starting point but from the objective is required.

This can be easily discovered by calculation, from the ranges already taken, and noted in the right-hand margin.

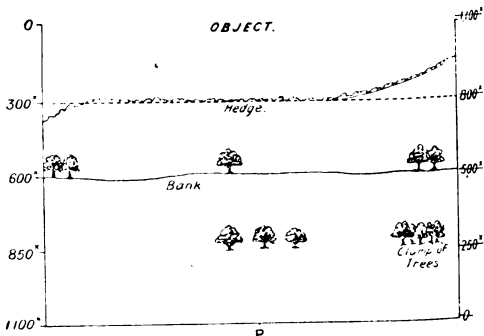


FIG. 2.

Instead of the objective being 1,100 yards in range, when reached its range will be 0.

Therefore 0 should be written against the objective in the left-hand margin, and 1,100 yards against the starting point.

The clump of trees marked as being 250 yards in the right-hand margin will be 1,100 — 250 = 850 yards.

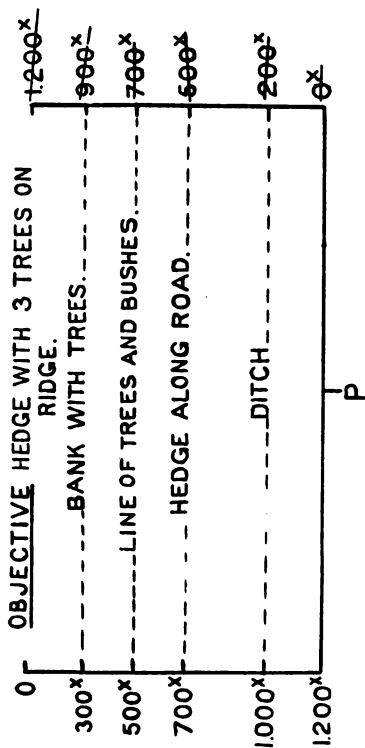


FIG. 3.

P = Position Point 300 yards N.E. of MILL. 1st G in GIGGLESWICK. MAP REF. NO. —.
 Date . . .
 Signature . . .

Thus the distances of the various points from the objective may be easily discovered, and noted in the left-hand margin.

The figures in the right-hand margin should then be crossed out, to avoid any possible error.

Note that all lettering should be done in block capitals, and that the position of the starting point P on the map should be noted at the bottom of the chart.

It may be found best, in some cases, to describe the various points on the chart, as in Fig. 3, instead of making a sketch.

Much care and practice are necessary for this work, and all opportunity should be taken in the making of both types of chart.

On field days, or during halts on route marches, there will nearly always be good opportunities for this work.

Range charts should on these occasions be made and criticised by the instructor, and any difficulties explained.

CHAPTER XIV

SIGNALS

At no time more than in the present war has the need for signalling been more keenly felt. The noise is often so great that a man can hardly hear himself shout, let alone convey his wishes to his No. 2's or N.C.O.'s. A proper system of signalling should therefore be arranged and practised, in order that communication can be correctly carried out.

The following signals may act as a basis on which to go :

The arms raised from the sides to the height of the shoulders until seen = "*Action.*"

Arm swung in circular motion shoulder high = "*Out of Action.*"

Hand up, No. 2 = "*Ready to Fire.*"

Hand up, machine gun officer = "*Prepare to Fire.*"

Hand down, machine gun officer = "*Open Fire.*"

Arms into side, hand moved backwards and forwards horizontally in front of body = "*Cease Fire.*"

A = More ammunition required.

P = Fire observed not less than 50 yards beyond target.

M = Fire observed not less than 50 yards short of target.

R = Correct range.

T = Fire observed to right of target.

L = Fire observed to left of target.

C = Direction correct.

U = Unobserved, repeat in order that observation may be made.

Q = Fire observed, uncertain.

CHAPTER XV

METHODS OF FIRE

I. RANGING FIRE.—This is used on occasions when the correct range to target cannot be obtained, owing to the absence of a range finder. This method is never necessary in trench warfare, but is used for open warfare—*only when absolutely necessary*. The chief disadvantages of ranging fire are :

1. It destroys the element of surprise, which is very valuable.

2. It is likely to reveal to the enemy the position of your machine gun or guns. Bursts of ten rounds should be fired, and the strike of the bullets observed. Under ordinary conditions ten rounds should be ample, but on ground where observation is difficult bursts of twenty may be necessary.

By observation and alteration of elevation the correct range is ultimately found.

It is best to start with range short, as

shots falling short are easier to observe than shots going beyond the target.

II. RAPID FIRE.—This is the normal method of fire with machine guns. It does not mean that a whole magazine of forty-seven rounds should be fired at a time; bursts of from *twenty to thirty* rounds should be ample.

In between each burst, No. 1 should relay his gun, and will continue to fire so, until he receives the order to cease fire.

III. SINGLE SHOT FIRING.—This method is seldom used. Single shots may be fired by pressing and quickly releasing the trigger.

IV. TRAVERSING FIRE.—(a) *Vide* Chapter IX for this method of fire. Bursts of five to ten rounds should be ample—250 rounds per minute is all that is required at most.

(b) *Swinging Traverse*.—During the present war this method has been considerably used against massed infantry attacks. This method should only be used against exceptional targets at short range.

CONES OF FIRE

Range Taking.—Owing to the close grouping obtained with machine guns, it is more important that the correct range should be found.

The following methods of range taking are found to have the following *probable errors* :

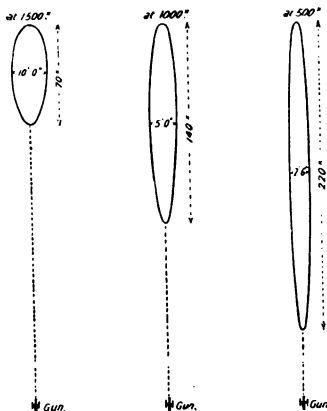
1. Range taking with instrument, probable error, 5%.

2. Range taking from key ranges, and range charts, probable error, 10%.

3. Range taking by judging distance, probable error, 15%.

With a machine gun 75% of shots fired will fall in a certain area called the *effective beaten zone* (E.B.Z.). At:—

500 yards	E.B.Z.	=	220 yards	in depth.
1,000	„	„	= 140	„ „
1,500	„	„	= 70	„ „



CONE OF FIRE (CONTAINING 75% OF SHOTS FIRED).

At 500 yards. Length = 220 yards. Breadth = 2 ft. 6 in.

„ 1000 „ „ = 140 „ „ = 5 „ 0 „

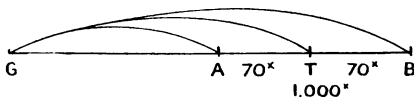
„ 1500 „ „ = 70 „ „ = 10 „ 0 „

The *permissible error* in ranging is half the E.B.Z. at that range. Thus :

500 yards permissible error = 110 yards.

1,000 „ „ „ = 70 „

1,500 „ „ „ = 35 „



If G = gun, T = target 1,000 yards range,

A T = 70 yards, T B = 70 yards A B = E.B.Z.

If error in ranging of 70 yards either way is made, a certain percentage of shots will strike the target.

At 1,000 yards the probable errors in range-finding would be: Method (1) 50 yards, (2) 100 yards, (3) 150 yards.

To counteract this error in range, three methods of fire may be used:

- I. Combined sights.
- II. Bracketing fire.

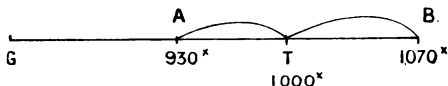
I. COMBINED SIGHTS

By this method, which is used with two or more guns, each gun is given a different range, thus increasing the total E.B.Z.

If $R = \text{correct range} = 1,000 \text{ yards}$,

No. 1 gun might be given 930 yards for range.

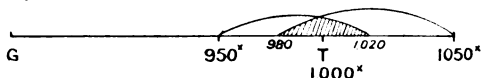
No. 2 gun might be given 1,070 yards for range.



No. 1 gun will hit T with its extreme shots.
No. 2 gun will hit T with its shortest shots.

But the density of fire at T will be small. In this case the difference between two given ranges = 140 yards.

If, however, the difference is reduced to 100 yards, No. 1 gun fires at 950 yards and No. 2 gun at 1,050 yards, the zones will overlap by 40 yards.



The density of fire is thereby greatly increased.

From 800 yards to 1,200 yards, differences of 100 yards may be used. From 1,200 (inclusive) upwards, 50 yards is the maximum difference allowable.

If more than the necessary number of guns are available, the following formula may be used :

$(N - 1) \times D + \text{E.B.Z.} = \text{depth of total beaten zone.}$ $N = \text{No. of guns.}$ $D = \text{Differences.}$ $\text{E.B.Z.} = \text{Effective beaten zone.}$ Supposing range = approx. 1,000 yards.

Probable error of 10% = 100 yards.

\therefore 200 yards must be depth of total beaten zone.

Let No. of guns = 4.

E.B.Z. for 1,000 yards = 140 yards.

We get the equation—

$$(4 - 1) \times D + 140 = 200$$

$$\text{Or } 3 D = 200 - 140$$

$$3 D = 60$$

$$D = 20.$$

Therefore necessary difference = 20.

From this formula :

No. of guns required }
 Total beaten zone } may be calculated.
 or difference }

Another method is to divide zone to be beaten by difference for that range. This gives number of guns required.

The combined sights method of fire has disadvantages, the greatest of which is that only a limited amount of fire is brought to bear on target. If, however, it is possible to observe fire, after a few bursts "Cease fire" may be given, and all guns elevated or depressed to correct range.

The advantages of this method of fire are :

1. It ensures the correct range being obtained.

2. Is therefore useful for surprise fire on a good target, although not so effective as if correct range can be given to all guns.

Orders.—The difference having been given out (suppose it is 50 yards, and that there

are four guns), the officer will give his range to the left-hand No. 1, who will pass to the next No. 1 the range he is using, thus :

“ Using 850.”

This No. 1 will pass on “ Using 900,” and so on, till the fourth No. 1 gets the intimation that he is to use 1,000 yards.

Combined sights are never used for ranges below 800 yards.

II. BRACKETING FIRE

For this method of fire two guns are required, or more.

If estimated range is 1,000 yards, and probable error in range-taking $10\% = 100$ yards, it is necessary to cover with fire the ground from 900 yards to 1,100 yards.

The left gun will fire at 900 yards, and the right at 1,100 yards.

A burst will be fired by both guns, who will then alter their sights to 950 yards and 1,050 yards respectively, and so on until they reach 1,100 yards and 900 yards.

If observation is obtained before this, “Cease Fire” will be given and observed range given.

Note.—The figures given are those in use for the Vickers Light Gun. In the case of the Lewis Gun, whose grouping is closer, it is probable that more than 75% of shots fired will fall in the E.B.Z.'s given.

CHAPTER XVI

ARRANGEMENTS TO BE MADE FOR TAKING LEWIS GUNS UP TO TRENCHES

IN going up to the trenches, take the gun and ammunition as far as possible on transport.

The nearer you can get the guns up on transport, the more carrying you save your men.

Ask the outgoing Lewis gun officer to explain to you where he placed his guns, and where they fired if necessary.

Get your guns into position as quickly as possible; it is usually best to follow the outgoing M.G.O.'s advice, at any rate for the first night, as he has greater experience of the position than you have.

Having put your guns in position, see that each has at least a case of magazines ready beside it, and a magazine in the magazine post.

If the gun is pointed through a loop-hole,

when it is growing light either the gun should be removed or the loophole stopped up with sandbags, which can easily be removed in case of attack. The latter is the better method.

When it becomes light, the machine gun officer should walk round the trenches of his battalion, and, if he thinks fit, should suggest the placing of the guns in different positions from those which they held during the night.

In doing this he must be careful not to do any digging or obvious building work during the day time; if he does, he is almost sure to be heavily shelled.

The advantage of changing the position is that, if the past machine gun officer has not been wise in his control of fire, the enemy have very likely marked down the position, and in due time will shell it heavily.

Alternative positions should always be chosen, in case one position becomes impossible, or is found out.

N.C.O.'s and No. 1's should have it clearly explained to them what portion of the front is most likely to provide a target; if possible, place each gun so that it *can* be laid on any point in the front.

In choosing positions or alternative posi-

tions, if possible have them on a flank, as in this case they are useful for enfilade fire, and can all sweep down the entire length of trench occupied by the battalion.

Do not have guns close together in trenches unless absolutely necessary, as one shell will then only injure one gun, instead of two.

The gun position should be as invisible as possible to the enemy; a curved emplacement in a straight trench is very obviously a place for machine guns in the enemy's eyes, and will be treated as such.

Do not fire the machine guns unless :

1. There is a very good target, with which rifle fire cannot properly deal.

2. The enemy attack your trench in large numbers so that you are really needed.

3. Your own men are attacking.

To fire otherwise is to give away your position and play into the hands of the enemy.

Often the enemy will fire their guns at night in the hope that your men will fire in return. Impress this very strongly on your men, and if possible mark down where the enemy machine guns are.

Make it a rule with your men that they

shall not open fire under ordinary circumstances unless they receive orders to do so.

Directly your guns have fired, take them to alternative positions, as your old position is almost certain to be shelled.

Ammunition Supply.—If there are good communication trenches, do not have too large a supply of ammunition in the front line trench, as a loss of the trench will mean the loss of a large and perhaps valuable number of magazines.

Three cases of magazines per gun should be ample in the front line trench (nine magazines per case).

In case of an attack, teach your gun numbers not to waste ammunition on bad targets, but to pick out good targets—100 rounds well expended are better than 1,000 fired at random.

A depôt for ammunition should be made in the support trench.

The machine gun officer's position should be as far as possible such that he can easily communicate with the headquarters of his battalion and with any or all of his guns. He should have an orderly with him always—in case he may need to send a message to any detachment.

CHAPTER XVII

THE TACTICAL USES OF MACHINE GUNS

No real appreciation of the tactical uses of machine guns in modern warfare can be gained, unless it is fully understood that there are two separate types of these weapons in use at the present time, each with its separate duties and uses, and each with its separate organisation and control.

The two types are briefly as follows :—

1. The light air-cooled guns, such as the Lewis Automatic Machine Gun, which greatly resembles an automatic rifle both in appearance and use. Two of these guns are issued to each company of infantry, and are controlled by the company officer assisted by the battalion machine gun officer.

2. The heavier water-cooled gun, such as the Vickers Light Gun, which is fired from a tripod of considerable weight, and so has all the advantages characteristic of the Fixed Platform.

These guns are collected together in one organisation or unit, called the Machine Gun Corps, and are supplied to the infantry at the rate of one machine gun company to an infantry brigade.

The control of these guns is under the brigade machine gun company officer, assisted by his subordinate officers, and it has been found that the co-operation essential to the successful handling of machine guns is more easily obtained this way than any other.

Co-operation is one of the great secrets of success in battle, and, in the case of machine guns, it is necessary not only between the various guns but also between the guns and the infantry or cavalry, and at the same time with the artillery.

Under this system the brigade machine gun officer should have the full benefit of any particulars and details which may be in the possession of the brigade staff, and so should be able to get the best possible value out of every gun under his command. Close co-operation is also essential between the Vickers guns and the lighter Lewis guns.

It will be seen that each type has special duties for which it is most suited, and that, for the other duties of machine guns, it must

necessarily depend on the other type to perform its work satisfactorily.

Having thus studied the types of gun at the disposal of the troops, it will be well to proceed to a consideration of the uses of machine guns :

- I. In the Attack.
- II. In Defence.

MACHINE GUNS IN THE ATTACK

A. THE PREPARATIONS FOR THE ATTACK

Preparation for the attack may be very nearly summed up in the one word "Reconnaissance." By this it is meant that long before the attack is to take place, every possible means must be used to gain all available knowledge—

- (a) Of the ground to be traversed before the enemy's position is reached.
- (b) Of the enemy's position itself.
- (c) Of the ground behind the enemy's position, and of any positions in the rear, to which the enemy may retire on being ejected from his front line.

(a) The ground intervening between the two positions can be examined with care by

field glasses and telescopes. Where the fighting is of the type that is called "open warfare," large-scale maps may be found to be of great use.

In this preparation, the means of getting the machine guns up into the enemy's line when it is captured by the infantry is the great consideration. This, needless to say, should be done, encountering as few obstacles as possible, but at the same time providing as much cover as can be used for the attacking party and its following machine guns.

The enemy have a very real respect for machine guns, so much so in fact that they employ special officers and men to keep a constant look out for these weapons, and to do their utmost to destroy them, assisted by the artillery at their disposal.

Thus it is that cover for the approach is most important, and that in trench warfare, where "No Man's Land" is usually a barren waste, a gun which is light and so can be easily brought up, resembles an ordinary rifle, and appears to be part of the attacking wave of infantry, is most useful for the early part of the action. At a later time, the heavier guns may be brought up under cover of darkness.

In open warfare, or where the ground to

be covered is broad, it is very necessary that some intermediate halting place, or places, should be discovered. Here cover is essential, and if possible it should be such that the machine guns may be utilised to assist the infantry in establishing a superiority of fire.

Another point to be considered in this part of the reconnaissance is the means by which ammunition may be brought up to the guns when they are established in their new position, and which entail a minimum of danger to the ammunition carriers and their burden.

(b) The next point to consider is the position of the enemy. Here again field glasses, and other means of observation with the infantry in the front-line trenches, must be fully used. Maps made in peace time, and on a large scale, may be found to be of use, but in nearly every case before an attack the aeroplanes will have photographed the enemy's positions, and these photos are of the utmost value, in that they give a very fair and accurate idea of the enemy's trench system.

This system must be studied with two objects. Firstly, the probable positions of enemy machine gun emplacements, and secondly the positions that the machine guns should take up in order that they may assist

the infantry to consolidate the position gained, and if necessary to proceed further with the attack.

To deal with the first, and perhaps the more important of these objects. Too often we read of attacks which have been "held up" by enemy machine guns which have escaped damage in the preliminary bombardment. One of the great objects of this preliminary reconnaissance is the discovery of these enemy machine gun positions. Officers and men should spare no pains to discover these position, and it should be borne in mind that a machine gun very rarely fires directly to its front, and that if an enemy machine gun fires, as it probably will, the place from which its emplacement is most likely to be seen is that at which its bullets strike.

The noise of the machine gun gives a certain indication of the approximate direction of its position, which may be found useful as a clue to its discovery. The only certain means of discovery is, however, by direct observation.

The flash of a machine gun at night cannot be taken as an accurate indication, as the probability is that the machine gun is only fired from a temporary position, and that

directly it has finished its night firing it is moved back to its proper day position, which it would occupy in case of an attack.

When any position has been discovered, it should be communicated to the artillery, who are the people most competent to deal with it. Where, however, an attack is intended, the emplacement should not be destroyed at once, as the enemy will only move their gun to another place, which may not be so easy to discover.

The correct method is usually to allow the emplacement to stand for the time being, and so let the enemy think they are secure; then, when the bombardment preliminary to the attack is commenced, the emplacement can be destroyed, and in the confusion it is unlikely that the enemy will have time to bring up more guns or make new positions.

In considering the positions in the enemy's trenches which are likely to be of most service to the attacking machine guns, it must be borne in mind that there are several duties which can be well performed by them.

They can be used to—

- (1) Turn the enemy out of positions on to which they hold after they have vacated their line generally.

- (2) Harry the retreating enemy, where opportunity offers, and so assist in the destruction of their morale.
- (3) Prevent any counter-attack from bearing fruit, so giving valuable assistance to the infantry while they are consolidating their position.

From the maps of the enemy trenches which are available, it may be possible to determine beforehand the positions of the various guns, and to allot to each its separate task.

(c) The position behind the enemy's front line must be considered in two lights. Firstly as to how the enemy's second line may be harried by machine-gun fire, while the newly captured position is being consolidated; and under this heading must come the places at which the enemy are likely to muster their troops for a counter-attack. Artillery will necessarily play a large part in this work, but the machine guns being nearer, and so able to have better observation, may very likely have golden opportunities of inflicting heavy casualties, by catching the enemy in mass, as they debouch, or even as they collect.

Secondly, if the attack is to be carried

farther, a knowledge of the extra ground to be covered is essential.

This is usually the hardest part of the reconnaissance, and much must depend on the accuracy of maps and aeroplane information.

From the foregoing it will have been seen that there is much important work to be done in the reconnaissance before the attack. The work, however, does not end here ; for, having gained all possible information about the ground upon which the attack will take place, and drawn up maps and plans, it is then necessary to scheme out the duties of each gun, and to make certain that there will not be a gun whose services are wasted.

Further, it is necessary to decide upon the places where ammunition depots will be formed, and these should be in strongly built dug-outs, to minimise the possibility of enemy shell fire destroying the ammunition, and so preventing a proper supply to the front.

Another important part of the reconnaissance will be played by the range takers, who will have to take the ranges of such points behind the enemy's line as they can see, and supply the machine guns with Offensive Range Charts. While this work should

be performed as much as possible in conjunction with the machine-gun officers, it is most necessary that the range takers should be capable of doing it competently without outside assistance, and this point should always be borne in mind during their training.

The secret of success in all reconnaissance and work of preparation is that every eventuality which can be foreseen should be planned for, so that, in the event of its occurrence, it may be dealt with as "part of the day's work," and not cause consternation and confusion, which may spoil the chances of success.

When the plans have been finally made, it is essential that all whom they concern should be fully acquainted with them, and that this knowledge should not be confined to a few, who may become casualties early in the fight, and leave the guns with no one who really knows the scheme of action.

Finally, it must be considered that there are two types of duties for the guns :

- (1) Some guns must follow as closely as possible on the heels of the attacking infantry, and, owing to their suitability for this work, the Lewis guns would be chosen.

- (2) The guns which remain behind, and give support and covering fire to the infantry.

B. THE ATTACK

(i) During the preliminary bombardment the machine guns can do very little, and it is probably better that they should be kept in some safe place, so that when the time comes for them to deal their blow, they will be able to work, and will not have run the risk of being put out of action beforehand.

Cases may occur, however, when it is possible to catch a large number of the enemy retreating from their destroyed trenches across the open, and such opportunities should not be missed.

(ii) It must at all times be remembered that machine guns, and their sections, are difficult to replace, and so there must be some certainty that the attacking infantry have mastered the new position before the guns can be sent up at all. Thus it is that the guns should not be moved forward until two or even three lines of infantry have gone over the parapet and reached the enemy line.

When they do go forward, the machine

guns must be made to appear as a part of the line of advancing infantry, and so attract as little attention and fire as possible.

The part played by the guns, when they reach the captured position, should now be examined.

(a) In open warfare, where the enemy will only have a hastily contrived form of cover, the machine guns can do much to assist the infantry to establish a superiority of fire, and so assist any further advance.

(b) In trench warfare, they can guard communication trenches : but, owing to the fact that these will either wind about or else be traversed, this task of preventing the enemy from working up and impeding the work of consolidation will probably have to be done by bombers working behind hastily erected barricades. The machine guns can, however, prevent the enemy from leaving their communication trenches and advancing across the open.

(c) The guns can also sweep the enemy's new position, and so render it dangerous for them to come up over their parapet, and in any way worry the infantry, by sniping or ordinary rifle fire.

(d) The harrying of the enemy in their retreat across the open by machine guns will

often convert an organised retreat into a rout. This will do much to destroy the morale of the enemy, and make it all the more difficult for him to collect his men to organise a counter-attack.

(e) A successful attack is nearly always followed after a brief space by a counter-attack, and here again the machine guns may be of the very greatest assistance. They can make it extremely difficult to advance across the open, and no attack of any size can be worked along a communication trench; for, as was seen above, if the enemy is confined to his trenches and prevented from working in the open, the bombers should be able to repel any attack.

(f) In the event of the new position being proved to be untenable through any cause, the retirement of the infantry can be covered and assisted by the machine guns. (For this part of the work *vide* the machine guns' duties in Defence.)

Now let us deal with the guns which have not gone up with the infantry, but which are assisting from their positions in the rear. The chief duties of these guns will be to give *support and covering fire* to the infantry.

They will probably be under the command

of the brigade machine gun officer, who will necessarily be kept informed of any new developments or intentions by the Brigade Staff. For this reason he should be in close communication with the Brigade Staff, if not actually with them, and should have a thorough system of communication with the guns under his command.

Owing to the likelihood of the wires of his telephones being cut, it is necessary that he should have a number of orderlies or runners, to carry messages for him, and he should not be stinted in the number of those he is allowed, as communication is of vital importance.

Here again it is necessary that very careful planning and forethought should be given to the duties to be performed by each gun, and we will examine what these duties may be.

(1) *Covering Fire from the Flanks.*—Every line of attacking forces has always had two flanks, but where, as in the present trench warfare, the trenches wind about and are very often at right angles to one another, there are usually many positions from which flanking fire may be brought to bear.

From these positions the machine guns can fire on the enemy trenches, and keep

the enemy from putting their heads up over the parapet, until the infantry are close upon them.

Not only should the enemy infantry receive attention in the trenches, but also the enemy machine guns, which may have escaped the preliminary bombardment, and which will open fire immediately the attack is launched. These guns will either fire from their emplacements, or be put over the parapet and so give a very good target. Where the emplacement is used, it is more difficult to damage either the gun or its crew, but this can very often be accomplished.

Not only must the machine guns work offensively from their flanking positions, but they must at the same time prevent the enemy from making any attack on the flank ; their work is therefore defensive as well as offensive.

(2) *Overhead Fire*.—From commanding positions in the rear, *i.e.* positions which are higher, or houses specially strengthened and fortified, the machine guns may fire on the enemy positions over the heads of the attacking infantry, until their proximity to the enemy renders this fire dangerous. Such fire must necessarily be carried out by experienced gunners, with guns mounted on

tripods, otherwise it will be a grave source of danger to the attackers.

When the attackers reach a position which renders further fire on the enemy positions in front dangerous they may be used for—

(3) *Harassing Fire to the Rear of the Enemy's Position.*—Such fire may be used to harass the retreating enemy, or to create a curtain of fire, and so prevent the enemy from bringing up reserves or from making an immediate counter-attack.

(4) Under the category of Harassing Fire comes the use of *Long Range Searching Fire*. This type of fire is used from commanding positions, to search out any possible roads or places of assembly for the enemy. The enemy are thus harassed from a distance, and often thrown into disorder, as, imagining themselves to be safe, they suddenly become aware of the patter of machine gun bullets, and casualties are caused.

Such fire must necessarily be carried out without any great knowledge as to the damage it is doing; the guns can only surmise where the enemy are likely to collect, and sweep these places.

Much may be done by Indirect Fire on such places, guided by observation from a flank or some higher position; and, just

when the enemy are mustering for their intended counter-attack, they may be thrown into disorder by the use of this method of fire.

At all times it must be remembered that machine guns are essentially a weapon of opportunity, and that all opportunities must be taken to the full, if they are to be of the greatest possible service to their side. Undoubtedly one of the greatest tasks of the guns is the destruction of the enemy's morale. Morale forms a very important part of all success or failure in war, and too much stress cannot be laid upon this point.

(5) There is yet another method whereby the machine gun can help the attackers in their advance.

If a machine gun can be got into an advanced position, either in our trenches or in front of them, so that it can bring enfilade fire to bear on the enemy, it will do much to discourage their defence. For just as they are preparing to deal with an attack on their front, they may find their trenches swept from end to end by machine-gun fire from an unsuspected and enfilading position.

MACHINE GUNS IN RESERVE

While a large percentage of the machine guns available will be used for aiding in the

attack, there will also be a certain number, which will be kept in reserve, and used during the attack where they are needed.

Unforeseen events, such as the disablement of another gun, or an unexpected check, may thus be dealt with by the reserve guns, which can be moved about at the will of the brigade machine gun officer.

These reserve guns should not be used unless it is absolutely necessary, as they form a very valuable asset to the attacking force should things go against them.

C. THE PERIOD OF CONSOLIDATION AFTER THE ATTACK

Where the attack takes place during the day, it will be the task of the Lewis guns, which have gone forward, to do the greater part of the work of defence against counter-attacks, aided by the heavier type of gun in the rear. And, under all ordinary circumstances, it will be found very difficult to move up the Vickers guns during daylight, as these guns are easy to distinguish from ordinary parties of infantry, and will probably draw destructive artillery and rifle fire upon themselves, where the enemy have facilities of observation left them.

When night comes the Vickers guns can, however, be moved up into new emplacements, while the guns which have been in reserve during the attack can be used to replace casualties, and to take the places vacated by the guns in reserve, and so form a valuable defence in case of a retreat being necessary.

Where the attack is to be continued and a farther advance is desired, the procedure will be the same as before, and the farther the attack proceeds the greater will be the value of the machine guns. Owing to the difficulty in moving up the artillery, it will be found that for a time machine guns will have to take its place, which they can do most effectively up to a certain point.

The less time the enemy have had to prepare their new position the greater will be the services of the machine guns in this respect, as machine guns cannot do the artillery work of damaging the enemy position itself, but can do much to harry the enemy where the cover is meagre and communication bad.

If the attack is not to be continued farther the duties of the machine gun pass to those of defence, and with this we will now deal.

MACHINE GUNS IN DEFENCE

Before a brigade enters a new line of trenches, the machine gun officers will have been given an opportunity to study the methods employed by their predecessors, by spending a day up in the trenches with them. Much may be learned from those who have experience of the peculiarities of any position, and from any maps or plans of their own and the enemy trenches which they may have. Therefore, before the Brigade ever enters the trenches, the machine guns should each have their allotted task, just as they would have in an attack.

Not only must the positions of the guns themselves be considered, but also those of the ammunition depots and filling stations.

In defence, just as in attack, the lighter and heavier type of gun will each have its particular positions and duties, and co-operation between them is as important as before.

THE NEED FOR DIAGONAL FIRE

We have seen how officers and men on each side are detailed for the special work of trying to locate enemy machine-gun positions, and for this reason, if for no other, it

Fig. 1. Firing to Front

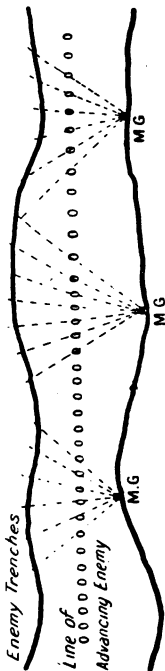
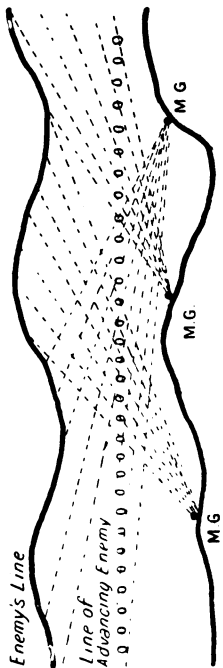


Fig. 2. Diagonal Fire



is of the greatest importance that the emplacements should be skilfully concealed.

If a machine gun is put firing to its front, the loophole is facing a part of the enemy's trench which is probably not far distant, and therefore the loophole is easy to see. Further, the gun will not cover a very great portion of the "No Man's Land" between the trenches (*vide* Fig. 1).

If, on the other hand, the emplacement is so made that the gun fires diagonally, so that it hits a portion of the enemy's parapet which is some way off and to its flank, the loophole will be less easy to locate, as it will be farther away and the noise will give the searcher less help than if it was directly opposite to him. Another great advantage in the diagonal method of fire is that any lines of attacking enemy are enfiladed, so that the bullets fired have a far greater chance of doing damage (*vide* Fig. 2). Fig. 2 illustrates the use of machine guns giving diagonal fire, and shows the great amount of "No Man's Land" covered by this method.

It will be seen that an advancing enemy would have to pass through a belt of machine gun fire, which could only be produced by a large number of machine guns firing to

their front. In each diagram only three guns are used, and there can be no doubt as to which method is the more economical both in guns and ammunition.

To produce this diagonal fire, and to ensure that no gaps are left in the belt of fire through which the enemy would have to pass, the greatest co-operation is necessary between the guns. Each gun guards the front of another, and in its turn has its own front guarded for it.

The field of fire need not be very great to produce this result, and it will be seen that the angle of traverse for each gun is considerably smaller in Fig. 2 than it is in Fig. 1. This means that the loopholes are smaller, and so, less visible.

From the foregoing it will be seen that the diagonal system of firing has very great advantages over the old firing-to-the-front method, and that it should be used wherever possible.

For this method of fire very careful planning is necessary to ensure—

- (1) That no gap is left in the belt of fire.
- (2) That no gun can traverse sufficiently to rake its own trenches.

The former of these points can easily be dealt with by a little thought, and by testing the field of fire of every gun, not only on the plan of the trenches, but also when the guns are in position; when the second point can also be dealt with, and the traverse checked, and the gun prevented from traversing too far, by placing some obstruction, such as a wooden peg or sandbag, in the loophole.

Alternative Positions

In the production of this belt of fire, it is most important that no gun shall be prevented from doing its share by the destruction of its emplacement; and, to guard against this, each gun should also have an "alternative position" to which it can be taken. This alternative position should have the same field of fire as the original position, and should not be too near to it.

If the alternative position is placed too near to the original emplacement, it may be destroyed by the same or a succeeding shell, for in all heavy bombardments the enemy will probably plaster one portion of a trench, and will very likely leave a position thirty yards off practically untouched.

THE USES OF THE TWO TYPES OF
MACHINE GUN

Owing to its fixed platform, or tripod, the heavier type of gun will necessarily have a very great advantage over the lighter in all traversing fire both by night and by day.

At night the gun can be laid on a particular point in the enemy's parapet, and will stay in that position ready to be fired at a moment's notice; this cannot easily be done with the lighter Lewis gun.

This does not imply, however, that the Lewis guns should not be used for diagonal fire in the daytime, and they should most certainly have loopholes from which this fire is possible.

They will also be found of very great assistance in guarding some narrow means of approach, such as a ditch or hedge, by which the enemy might seek to make an assault upon the trenches. For this work a heavier gun would be wasted, and so the Lewis can play its part.

Worrying Tactics in trenches can also be well done by the Lewis guns, which can be suddenly concentrated on any part of the enemy's line, and produce a great volume of fire for a short spell, without in any way

impairing the belt of fire, which is the chief duty of machine guns in defence.

It should also be borne in mind that the guns are very apt to betray their positions when they fire, and that the proper emplacements should not be used for any worrying fire on the enemy, but should be kept for repelling an attack by the enemy. This means that the guns must never fire unnecessarily from the ordinary emplacements which they would use in case of an attack, and that any firing which is not connected with actual defence must be done from temporary emplacements, from which the guns can be removed immediately after firing.

Therefore the Lewis guns are better suited on the whole for ordinary "Worrying Tactics" than the heavier type of gun.

THE CHOICE OF POSITIONS FOR MACHINE GUNS

Machine guns must necessarily be divided under two headings :

- I. Those in the Front-line Trenches.
- II. Those in Support, and in the Rear.

It will be the duty of the first set of guns to repel, if possible, any attack that may be

made, while the second set of guns, in the rear, will check that attack from developing further, should it succeed in penetrating the front line, and to assist in any counter-attack that may be made.

I. *Positions in the Front Line.*—From Fig. 2 it will be seen that in order to bring diagonal fire to bear upon as great a stretch of ground as possible the guns must be placed in parts of the trenches which are slightly in advance of the rest.

Care must, however, be taken not to place a machine gun in the apex of any salient, as such points are always the objects of close attention from the enemy. The guns should, for preference, be placed on the sides of such a salient, where they will be able to perform their work with equal chances of success.

It is also important that the guns should not be placed too close together—as, if this is done, they will be more likely to be destroyed by enemy artillery fire. One gun may be located by the enemy, and in the efforts which he will make to destroy it the second gun will, in all probability, be destroyed.

The positions of the guns should also be chosen so that their fire is, as far as possible, a “grazing fire,” as by this means their

chances of striking some target, even if they miss their intended mark, are increased. For this it is necessary that the guns should not be in too commanding a position, and that if possible the slope of the ground should conform to the trajectory of the bullet.

Their duty, as was seen above, is to destroy any enemy attack, and it is more the duty of the guns in the rear to fire on enemy positions in the rear, for which a commanding position may be necessary.

II. *Positions in Support*.—The machine guns in the rear have three definite uses:

- (a) The checking of any enemy attack which may penetrate the front-line trenches, and assisting the counter-attack.
- (b) The assistance of the guns in the front line.
- (c) Firing on enemy positions in the rear.

Where it is possible, the machine guns in the rear should have a certain proportion of their number allotted to positions from which they can enfilade the front-line trench, and so render the life of the enemy in their newly captured trench extremely hazardous until

they have converted the old parados into a new parapet. Communication trenches should also be enfiladed, where possible, to prevent the enemy working along these until a barricade can be erected by the retreating forces.

In addition to this work, they will be able to prevent the enemy from advancing across the open, and so limit their facilities for advance.

This command of the front-line trenches will also enable the guns to assist any counter-attack that may be made, by giving covering fire from the flanks (*vide* Machine Guns in the Attack), and by forcing the enemy to keep down, and preventing them from firing on the advancing troops.

It must be borne in mind that the enemy will have no communication trenches up to their new position, so that any reinforcements, of men or ammunition, will have to be brought across the open, and these guns can greatly hinder any such attempts.

(b) and (c). The uses of commanding positions are great for machine guns in the rear. Where possible, a rise in the ground should be used in preference to any cover that is likely to give a mark for the enemy's artillery, such as a building; for it is quite certain

that, in any bombardment, such an object would receive its share of attention.

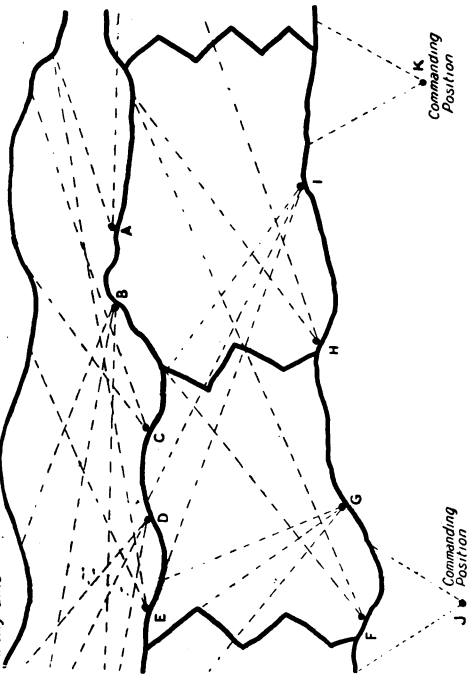
From such a position the ground behind the enemy's line may be watched and any roads or means of approach may be swept by machine-gun fire, and the bringing up of reinforcements hindered.

Such a position in the rear may be very useful for night firing, and harassing parties bringing up supplies, or relieving troops, as the fact that the guns are farther from the enemy position will make it very difficult to locate them.

From a commanding position it will be possible to give assistance to the guns in the front line, in repelling an attack, by means of overhead fire.

Finally, it may be said that in the present war strongholds containing a large number of machine guns have frequently held up an advance; for, as long as these places can hold out, they will prevent the enemy from penetrating farther, by bringing enfilading fire to bear upon his positions.

Such positions in the rear are rendered all the more capable of damaging the enemy, owing to the fact that he will probably be forced to create new trenches, and for a con-



PLAN SHOWING DISTRIBUTION OF MACHINE GUNS IN TRENCHES.
A, B, C, D, E, F, G, H, I, AND J ARE MACHINE GUN POSITIONS.

siderable period such trenches will be far from perfect.

The accompanying figure (Fig. 3) shows how machine guns might be placed in an imaginary system of trenches, each gun having its allotted task.

A certain number of the guns in the rear will be kept in reserve, ready to be moved to any critical point or where their service may be needed.

Where the sections are in the trenches for any considerable period the reserve guns may relieve the working sections, and so a system of reliefs may be kept up.

In conclusion, it may be as well to draw attention, once more, to two important points.

I. The need for co-operation.

II. The great importance of not firing the guns unless a good target is offered, so reducing not only the wastage of ammunition, but at the same time the chances of the enemy locating the positions.

CHAPTER XVIII

RANGE TAKING

It is desirable that all members of Machine Gun Sections should be practised in *judging distance*, and competitions in this should be encouraged by section officers, who should also train themselves to be able to judge a distance as quickly and accurately as possible.

Where a range-finder is not available and time allows, greater accuracy can be obtained by taking the opinions of several men as to the range of an object, and taking the average.

A good working knowledge of the range-finder and its use should be had by all members of a section; more especially in the cases of the officer and range takers.

The men who are always to be "range takers" should have special training and practice in this work, as it is only by experience that the range taker learns to pick

out those objects whose range can be found most accurately, on account of their shape and outline.

The qualifications necessary for a good range taker are good eyesight, quick intelligence, and ability in the recognition of targets (Chapter XII). It is most necessary to choose range takers with care, as an untrustworthy range taker is worse than useless. *The choice of objects for range-taking purposes* is, of course, mainly governed by the circumstances of the case, and it is the choosing of objects whose ranges are most likely to be needed that enables a range taker to show skill or the reverse.

The following points may, however, be of assistance :

1. Choose objects whose outline is distinct, straight and regular, if possible.
2. An object of vertical or horizontal outline can be more accurately ranged upon than one whose outline is diagonal.
3. Where range of an object of diagonal outline has to be found, choose its summit, if possible ; *e.g.* a pointed church spire, or roof gable.
4. In cases where ranges have to be taken

along a road, if possible make use of telegraph posts, or failing them, the trunks of trees.

5. If the ranges of various points in a hedge are required, search out as far as possible any small trees in the hedge, and use their trunks. It is almost impossible to find the range of a bush with any degree of accuracy.

6. Where the range of infantry or cavalry is required, it is often easiest to choose the legs of a man or a horse.

7. Where the roof of a building is practically parallel to the base of a range taker, take the whole ridge of the roof in the case of a one-man Barr & Stroud range-finder. But where the roof does not run parallel, the apex of a gable or chimney should be used.

8. *Always, in making out a range chart, be quite clear in the description of the objects whose ranges have been taken.*

RANGE-FINDERS

These instruments may be divided into two headings :

- I. "One-man" range-finders.
- II. Range-finders which cannot be used by a single range taker.

I. "ONE-MAN" RANGE-FINDERS

The Barr & Stroud.—The range-finder most used for machine-gun work in the present war is without doubt the "Barr & Stroud One-Man Range-Finder."

This instrument can be easily carried in its canvas case by one man, and takes up very little room.

1. This instrument has a fixed "Base" of 31.5 inches.

2. The elementary working of the instrument may be explained by the following diagram (Fig. 1):

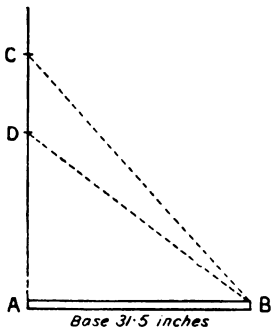
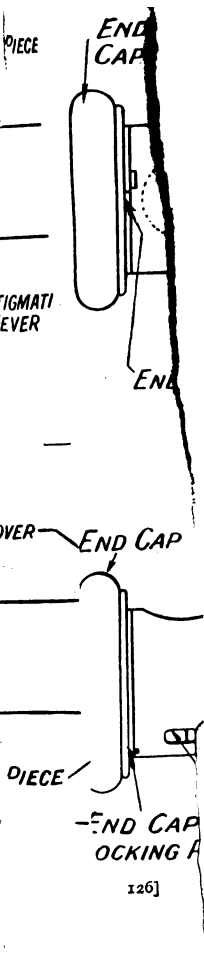


FIG. 1.



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$AB = \text{the base} = 31.5 \text{ in.}$

C and D are two objects whose ranges are required.

For a fixed base the range of an object along the line ACD will be proportional to the angle at B , *e.g.* the angles DBA and CBA .

So that the angle at B is a method of deciding the range of any point such as C or D .

The instrument has two eye-pieces.

The right looks upon the object (*vide* Fig. 2), and the left at an indicator.

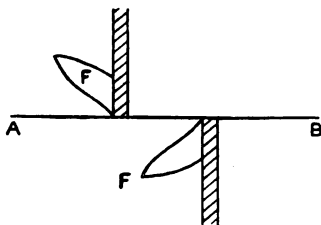


FIG. 2.

The vision in the right eye-piece is divided across by a line AB .

Above AB the object (F) will appear in a

reversed position, while below the line it will be the right way up.

In Fig. 2 the vision is shown when the instrument has not been adjusted to the proper range.

By the turning of the working head the objects should be brought so that they coincide.

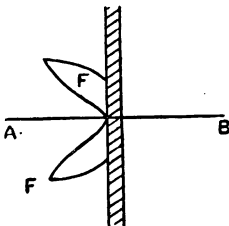


FIG. 3.

The indicator, read with the left eye, will now give the correct range.

Three readings should always be taken, the average being the correct range.

The indicator appearing as in Fig. 4.

The indicator may also be read by raising the "scale window cover" in front of the left eye-piece and reading another scale, which will be seen there. Thus a second person is able to read the range.

Supposing that the images are not touching the line, but are as in Fig. 5.



FIG. 4.

The two handles should be turned towards the range taker, thus depressing the line of vision until the two images touch the line.

In the same way the trunk of a tree should be brought on to the line A B.

If an object is vertical, care should be taken to keep the range-finder horizontal, thus ensuring that the two images

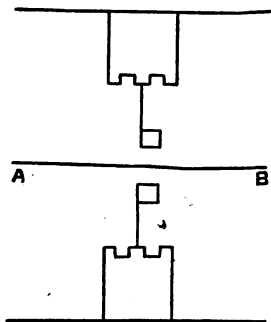


FIG. 5.

will be at right angles to the line A B, and *not* as in Fig. 6.

This can be done easily by pushing one of the handles up or down so that the clamp

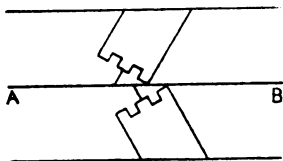


FIG. 6.

to the tripod allows the finder to become horizontal.

If, however, an object is not vertical, the

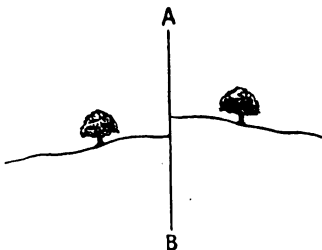


FIG. 7.

range-finder should be tilted until the images are vertical to the line A B.

The range of the horizon may be found

by holding the instrument vertically, so that the horizon appears as in accompanying drawing, and the images brought to coincide on A B as before (Fig. 7).

The Height of Image.—It may be found that the two images are not of the same level in the two mirrors, as in Fig. 8. This

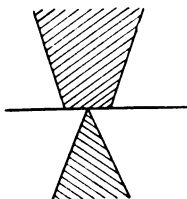


FIG. 8.

can easily be remedied by turning the *halving adjusting head cover ring* until the *halving adjusting head* is laid bare. Turn this while looking through the eye-piece, until the images are of the same height in the mirrors.

Arrows on the outside show which way the head should be turned to raise or lower the image.

Focussing the Images.—This is done by the focussing lever on the right eye-piece. Before reading the range the object should always be properly focussed, as otherwise a correct reading is difficult to obtain.

Where it is necessary to find the range of objects which are shining in the sun, *e.g.* a window, or a piece of glass in a field, the *astigmatiser* may be used; this elongates the images so that it is easier to make them coincide on the line A B. This is done by the *astigmatiser lever*.

To Test and Adjust Zero.—It is advisable to check the correctness and accuracy of the range-finder constantly.

To do this the height of image must be properly adjusted beforehand.

There are four methods of adjusting and testing zero.

1. On the rods in the wooden case.
2. On an accurately measured distance.
3. On the moon or a star.
4. On two points in opposite directions at unknown distance.

METHOD 1: On the Rods in the Wooden Case.—For this a piece of ground giving a clear view of not less than 300 yards is

required, the most effective distances being between 400 and 500 yards.

A man should be sent out with the wooden

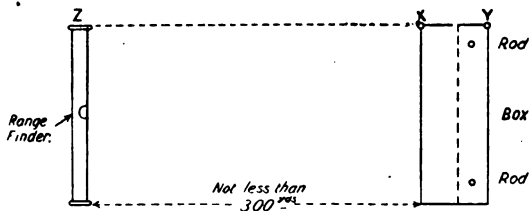


FIG. 9.

box ; he will place it so that it can clearly be seen from the range-finder.

He will then put the two black and white rods into their sockets in the box.

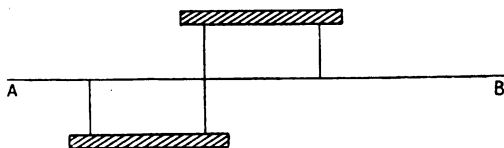


FIG. 10.

The range-finder having been placed upon its stand, he should then place the case so

that the rods are parallel to the range-finder.

This can be done by aligning the two corners of one end of the case on to the end of the corresponding end of the range-finder.

In Fig. 9 he would align Y, X, and Z.

The method of testing is to take six readings, making coincidence as in Fig. 10.

Should the average of these readings bring the reader apex of the indicator to such a position that the infinity mark is opposite the base of the reader, Fig. 9, note this fact and allow for it in reading the indicator in future.

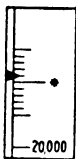


FIG. 11.

Should this not be the case, and the average not bring the reader to such a position, set the range scale at infinity, and again look at the two images.

Turn the zero adjusting head cover ring until the zero adjusting head is bare, and turn the zero adjusting head until coincidence, as in Fig. 10, is obtained.

The following points should receive attention :

1. The images should be at right angles to the line A B.

2. A piece of ground should be chosen, such that the rods can be clearly seen.

3. The range taker when he is making his adjustment should not try to observe at the same time; as he will very likely turn the adjusting head the wrong way.

4. The coincidence of the images should be made low down on the rods. This minimises the errors made owing to the rods not being parallel.

METHOD 2: *On an Accurately Measured Distance.*—Such a distance should be known to be accurate, the tester should not be guided by mere hearsay.

The distance should not be less than 800 yards.

If correct range is 900 yards, make the images coincide by means of zero adjusting screw head.

Several readings should then be taken to test the accuracy of the adjustment.

METHOD 3: (a) *On the Moon*, (b) *On a Star.*—(a) Readings should be taken on the moon, care first being taken to ensure that the height of image is in proper adjustment.

Take six ranges on the moon, and proceed as in Method 1.

This is not a good method of testing unless carried out by experienced range takers.

(b) On a star. (a) The star will appear as a point of light. Six readings should be taken and adjustment carried out as in Method 1. (b) Using the astigmatiser will cause the star to appear as a line of light (procedure as before).

METHOD 4: On Two Objects in Opposite Directions of Distance Unknown.—This must be carried out between two objects not less than 600 yards apart. It is better to use two objects about 1,000 yards apart.

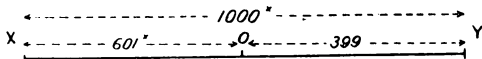


FIG. 12.

Set up the range-finder at O, and first take range of X, and then of Y. Six readings of each should be taken (Fig. 12).

Supposing OX to be 601 yards,
 and OY to be 399 ,,
 The total will be 1,000 ,,

The two distances should be approximately the same; if this is not so, the instrument should be moved (Fig. 13).

So proceed to O' :

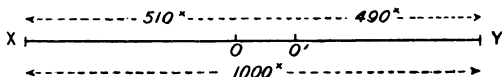


FIG. 13.

Take readings again, suppose that

$$O X = 510 \text{ yards.}$$

$$O' Y = 490 \text{ yards.}$$

$$\text{Total} = 1,000 \text{ yards.}$$

Then proceed to X or Y, and take the range of the other.

Suppose X's range is taken and is found to be 1,050 yards.

But $O X$ and $O' Y = 1,000$ yards.

This gives a difference of 50 yards. Multiply this difference by 2.

$$50 \times 2 = 100.$$

Subtract this from the second reading, *i.e.* 1,050. This gives

$$1,050 - 100 = 950.$$

950 yards is the correct range.

Procedure may now be the same as in Method 2.

Of these methods, Method 1 is the easiest to perform under active service conditions, when the range-finder may be tested when the battalion is in billets.

The Marindin One-Man Range-Finder.—The principle of the working of this instrument is the same as that of the Barr & Stroud (*vide* 1).

The images are, however, set differently (*vide* Fig. 14).



FIG. 14.

The two images are both the same way up; it is therefore necessary to range on an object which has a distinct outline for some depth.

As in Fig. 13, coincidence should be obtained at a point about the centre of a vertical object.

The horizon may be ranged upon by holding the instrument vertically.

The halving test may be carried out as in

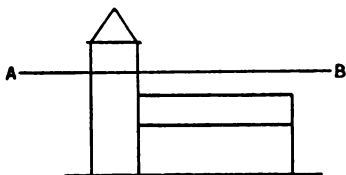


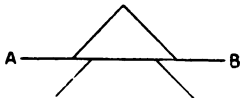
FIG. 15.

the Barr & Stroud; the gable of a house forms a convenient object for illustration.

(1)



(2)



(3)

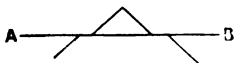


FIG. 16.

In (1) Fig. 16, the halving is correct; in (2) Fig. 16, the halving is too high; in (3) Fig. 16, the halving is too low.

To Adjust.—Either of the revolving rings should be turned until a plug is exposed. This plug can be screwed *inwards* by means of a key, until a hole is disclosed.

This hole contains a screw, which may be turned by the key.

A very slight turn of this screw will rectify any error.

In the case of image being *too high*, adjust the left prism by turning the screw outwards. In case of image being too low, adjust right prism by turning screw inwards.

Zero Adjustments.—The methods for the adjustment for zero are the same as for Barr & Stroud, *viz.* :

1. On the rods in the wooden case.
2. On an accurately measured distance.
3. On the moon or a star.
4. Two points in opposite directions at unknown distances.

METHOD 1 : Proceed as in (1) of Barr & Stroud, and if error is slight, note in the reading of future ranges. If it is great, set the drum to infinity, unscrew the zero adjusting screw cover. If the images appear as in Fig. 17, turn the adjusting screw to left

with the key until the images appear as in Fig. 18. Then check the correctness of



FIG. 17.

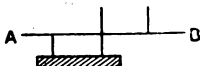


FIG. 18.

the adjustment by taking six readings and taking the average.

The adjusting screw cover should then be replaced.

As in the case of the Barr & Stroud the following points require attention :

(a) The images should be at right angles to the line A B.

(b) The length of base of instruments varies. The case belonging to the instrument about to be tested should therefore be used.

(c) The rods should be placed with a view to their being easily seen. A good background is required.

(d) The range taker should not look through the instrument while carrying out the adjustment.

(e) The coincidence should be made low down on the rods in case the rods are not parallel.

METHOD 2: As in Barr & Stroud. Adjustment being done by key.

METHOD 3: (a) As in Barr & Stroud. Adjustment being done with key. (b) Patterns, Mark II and III, are fitted with astigmatic glasses.

METHOD 4: The same as for Barr & Stroud.

There are other one-man range-finders. In most cases these are light instruments, capable of being carried in the pocket.

In nearly every case it is necessary to pace out a base of 10 yards or more with these instruments.

The base is longer as the range increases. Mr. Charles Hymans, optician, of Cambridge, has produced a reliable little range-finder of this description that can be recommended safely.

II. RANGE-FINDERS REQUIRING TWO OR MORE MEN

The best-known of these is the mekometer. It is, however, rarely if ever used for machine gun work now. For instructions readers are referred to "The Handbook of the

Mekometer," 1911. Published by His Majesty's Stationery Office, and sold by Messrs. Wyman & Sons, Ltd., Fetter Lane, E.C.

The mekometer consists of two instruments: the "Right Angle" instrument and the "Reading" instrument.

For this instrument a 25-yards base is sufficient for all machine-gun work.

This base is obtained from a reel which contains 25 yards of cord. One end of this cord is held by one range taker, while the other extends it till taut.

Where ground does not permit, a base of $12\frac{1}{2}$ yards may be used; readings will, however, not be so accurate.

APPENDIX

UNDER certain circumstances it may be possible to fix the gun to a tripod, or in such other manner, so that it will have the advantage of Fixed Platform, and be able to be used for

- (1) Night Firing
- (2) Overhead Fire
- (3) Indirect Fire

NIGHT FIRING

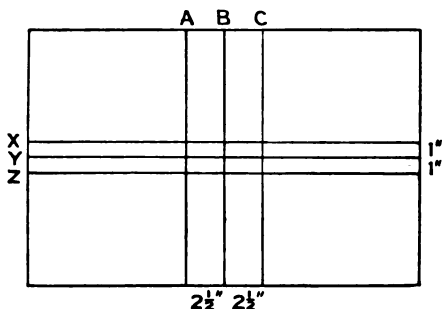
This method of fire is used at night, when darkness prevents the target from being clearly defined.

A machine gun put to guard a bridge will require some method of ensuring that it will hit the bridge, although it cannot be seen and also to relay after firing.

The gun is laid as required by daylight and a box, inside of which a candle or electric

light can be placed, and which has one side lined to allow light to come out, is placed 10 yards in front of gun, and in a line with gun and target. (A wooden box with parchment side will satisfy conditions in case of emergency.)

The gun having been correctly laid, the sights are put up, *but the elevation not altered*,



until sights are on the intersection of the centre lines, B and Y.

A, B, and C are parallel, and $2\frac{1}{2}$ in. apart. X, Y, and Z are also parallel, and 1 in. apart.

Vertical searching may be done by altering aim between X and Z, while Y is always the checking line for elevation.

Traversing may be done between A and C, B being direction checking line.

2½ in. at 10 yards = a traverse each side of 10 ft. at 500 yards. This is ample.

In trenches the white stump of a fallen tree or an old biscuit tin acts as a very good checking mark for night firing.

OVERHEAD FIRE

THIS method of fire may be used to cover the advance, or retreat, of friendly troops. In either case the gun must be in such a position that the target, the troops advancing, and the gun are not in the same plane.

Supposing that our trenches were on one side of a valley and the enemy's on the opposite hill; then in the event of our making an attack, overhead fire could be used to advantage.

It is obvious that it is only possible to support the attack up to a certain point, and after that there would be a great danger of shooting our own men. Therefore an imaginary line must be drawn, and after the advancing troops have passed this line

the supporting machine guns must cease fire or elevate, and so create a "curtain of fire."

Before using this method of fire, great care should be taken to see that the tripod is on firm ground, and that the elevating gear is well adjusted.

A bad mounting or much play in the tripod will of course greatly increase the safety angle necessary.

All angles given are as used for the Vickers Light Gun, for which they are considered safe.

For the Lewis gun, whose grouping is as good if not better, these angles should be absolutely without the slightest risk.

The angle between this line and the target is called the *angle of safety*.

This method of fire *cannot* be used for ranges over 1,500 yards, owing to the likelihood of many shots flying wide.

It is also most important that No. 1 should be a thoroughly experienced and trustworthy firer.

For ranges up to 1,000 yards the angle of safety must not be less than *thirty minutes*.

For ranges up to 1,500 and over 1,000, the angle of safety must not be less than *sixty minutes*.

There are three methods for determining this safety angle :

- (a) Graticules.
- (b) String and card method.
- (c) Tangent sights method.

(a) *Graticules*.—The distance between the zero line and the 600 yards line gives an angle of *thirty minutes*, and that between zero and 1,000 yards line *sixty minutes*.

The zero in each case should be set on the target ; the required line will then show the position in the ground beyond which attacking troops cannot be supported.

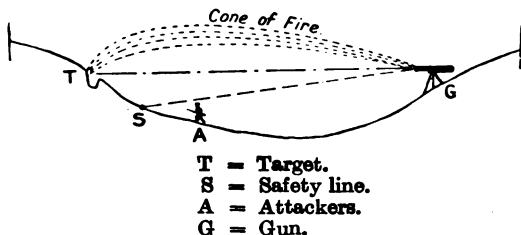
(b) *String and Card Method*.—Required, a piece of string 25 in. long and any card—on this card draw three lines :

0	—————	The distance between 0
30	—————	and 30 to be 21 in., and
60	—————	between 0 and 60 42 in.

Make a hole in the card, and put the string through it, knotting it, so that total length of string equals 24 in.

Hold string to eye and hold out card so that the string is tight—place the 0 line on the target. For under 1,000 yards the

30 line will give the angle of safety, and over 1,000 yards the 60 line is the line to mark.



Thus from this diagram the machine gun officer's card has its zero line at T, and his 30 or 60 line at S, according to range.

Beyond S it is dangerous to support attackers.

(c) *Tangent Sight Method*.—Take the range accurately, and lay the gun on target with correct range.

If the range is under 900 yards, raise it 400 yards; if range is 900 yards or over, raise it 250 yards. This will cause the line of sight to be at some point short of the target.

By this method S (see diagram) can be obtained.

Note.—The error in range must not exceed 5% for this method of fire.

INDIRECT FIRE

This method of fire is used when the gun can, with advantage, be behind a hill or some other obstacle, and is thus entirely out of sight of the enemy.

No. 1 cannot see the target, but the machine gun officer goes to a *flank* or to the *rear*, and observes the result of the bursts of fire, and signals to No. 2 or the N.C.O. (*vide* Chapter XI), who communicates with No. 1.

The advantage of this method of fire is that the gun is entirely hidden ; but for all ordinary purposes the necessarily slow firing, and the preparation necessary, quite outweigh the advantages.

It has, however, been used for searching hollows or woods to see if any of the enemy are lurking there.

There are two methods :

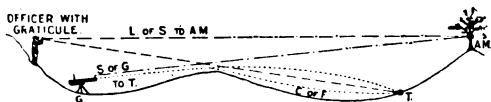
- (A) Graticules.
- (B) Spirit level method.

Under no circumstances must the observer be more than 6 ft. above or below the gun for former method.

(A) GRATICULES

Obtain range of the target, and, having done this, take a graticule, and from a position where the target can easily be seen.

Place the correct range line on the graticule, on the target, and see if any other line cuts a convenient aiming point, *e.g.* the fork in the branch of a tree. Care must be taken to see that this aiming point is easily visible from the gun position, and also that aiming



mark is approximately vertically above target, when viewed from gun position.

Order No. 1 to set his sights at the range which is marked on the graticule by the line cutting the aiming mark.

Supposing correct range to target is 1,200 and range of line is 600, No. 1 will then aim at the aiming mark with sights at 600, and he will then strike the target.

Fire can be observed and corrected, if necessary, either by message or by signals.

L. of S. to A. M. = Line of sight to aiming mark cut by line on graticule.

A. M. = Aiming mark.

T. = Target

S. of G. = Sighting of gun on aiming mark.

C. of F. = Cone of fire striking target.

(B) SPIRIT LEVEL METHOD

The gun having been mounted, a spirit level is then put upon it.

The sights are at range zero.

Having made the gun absolutely level, send a man out with a cap or some obvious object, *e.g.* a handkerchief, and make him put it so that the gun in its level position is aiming at it.

This object must also be in a direct line between the gun and the target.

Next obtain range of target and put sights at that range, and elevate gun so that it still is sighted on the aiming mark.

It will now hit the target.

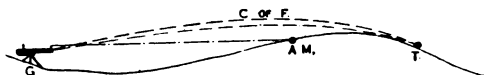
It is important that the gun having been elevated, the sights should be put down to

zero, and checked to see whether the shots will clear the obstacle.

If it is found that they will not, then the gun must be taken further back.

If the aiming mark is placed on summit of obstacle, this can be easily checked before gun is elevated.

For this method the gun and target must be roughly on the same level.



SPIRIT LEVEL METHOD

A. M. level with gun at range on sight at O.

C. of F = Cone of fire striking target, with sights at range of target and gun elevated to sight on aiming mark.

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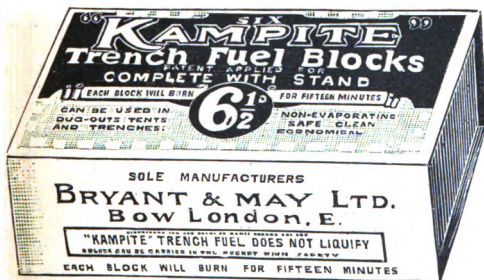
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